CONTENTS

FOR ENGINEERS AND CONTRACTORS CONTROLLING THE DESIGN, SPECIFICATION, INSTALLATION AND MAINTENANCE OF HEATING, VENTILATING AND AIR CONDITIONING.

HEATING & VENTILATING
AIR CONDITIONING

FOR MARCH, 1940

Heating and Cooling the World's Largest Airport . . . 17
Chemical Conditioning for Customers' Comfort 23
Heating a Modern Cottage Type Prison 25
Gas Engine Cuts Air Conditioning Power Cost 71% . . . 28
Profits in Air — The Standard Register Co. 30
Profits in Air — American Fork & Hoe Company 35
Profits in Air — Dust Control 38
When the Contractor Signs an Order 42
Estimating Heat Flow Through Sunlit Walls — Part 1 . . . 43
Solving a Tricky Air-Conditioning Problem 48
Air Filters Tested for Effectiveness 49
Abstracts 50
Editorials 54
Reference Data, 169 and 170 54
News of the Month 55
With the Manufacturers 59
New Equipment 60
Degree-Days for January, 1940 66
Coming Events 68
H & V's Photos 68
New Trade Literature 71

Photograph used on this month's cover is by courtesy of Pontiac Motor Division, General Motors Sales Corporation.

IN THIS ISSUE:

WORLD'S LARGEST AIRPORT

Heating a building in which one could place two complete football grid-irons and which has 80% of its wall area as doors, involves problems which would trouble any heating engineer. When this is just one of eight buildings differing in type and style, the problems involved are, to say the least, troublesome. On page 17 is an article which describes how these problems were licked in heating New York City's new LaGuardia Field.

SUN HEAT

One of the most difficult problems in summer cooling work has been the estimation of the effect upon cooling load of sunlit walls and roofs. Up to the present time it has been necessary to make rough estimates in order to calculate these quantities. However there is now available a rational method of determining this load which should considerably simplify these estimations. See page 43.

CHEMICAL CONDITIONING

When the Crosby's, famous restauranteurs of Cleveland, built their new restaurant, they told the air conditioning contractor that they wanted a "better" air conditioning system. They told him that they expected to pay more for such a system and that they would put the complete design in his hands. For details on the type of system he gave them, see page 23.

PROFITS IN AIR

Heading the Profits in Air section this month is an article which describes the year round air conditioning system installed in the new Standard Register Company's building in Dayton. In another article is described the new exhaust ventilating system which the American Fork & Hoe Company installed to improve conditions in its paint dipping department. Also included is the first of a series of articles on dust control in industry. This series will outline a program for a complete system of dust control.

PRISON HEATING

Heating practice in prisons differs in many respects from practice in ordinary commercial buildings. On page 25 is an article which describes in detail the heating system installed in a modern cottage type prison.

Copyright, 1940, by The Industrial Press

HEATING & VENTILATING is published monthly by The Industrial Press, Robert B. Luchars, President; Edgar A. Becker, Vice-President and Treasurer; Erik Oberg, Secretary. Published at 148 Lafayette Street, New York, N. Y. Western Office, 228 North La Salle Street, Chicago, Ill. Yearly subscription in United States, Spain, South America, Mexico, and Canada, $2.00; in all other countries, $3.00. Single copies, 30 cents. Member of Audit Bureau of Circulation and Associated Business Papers.

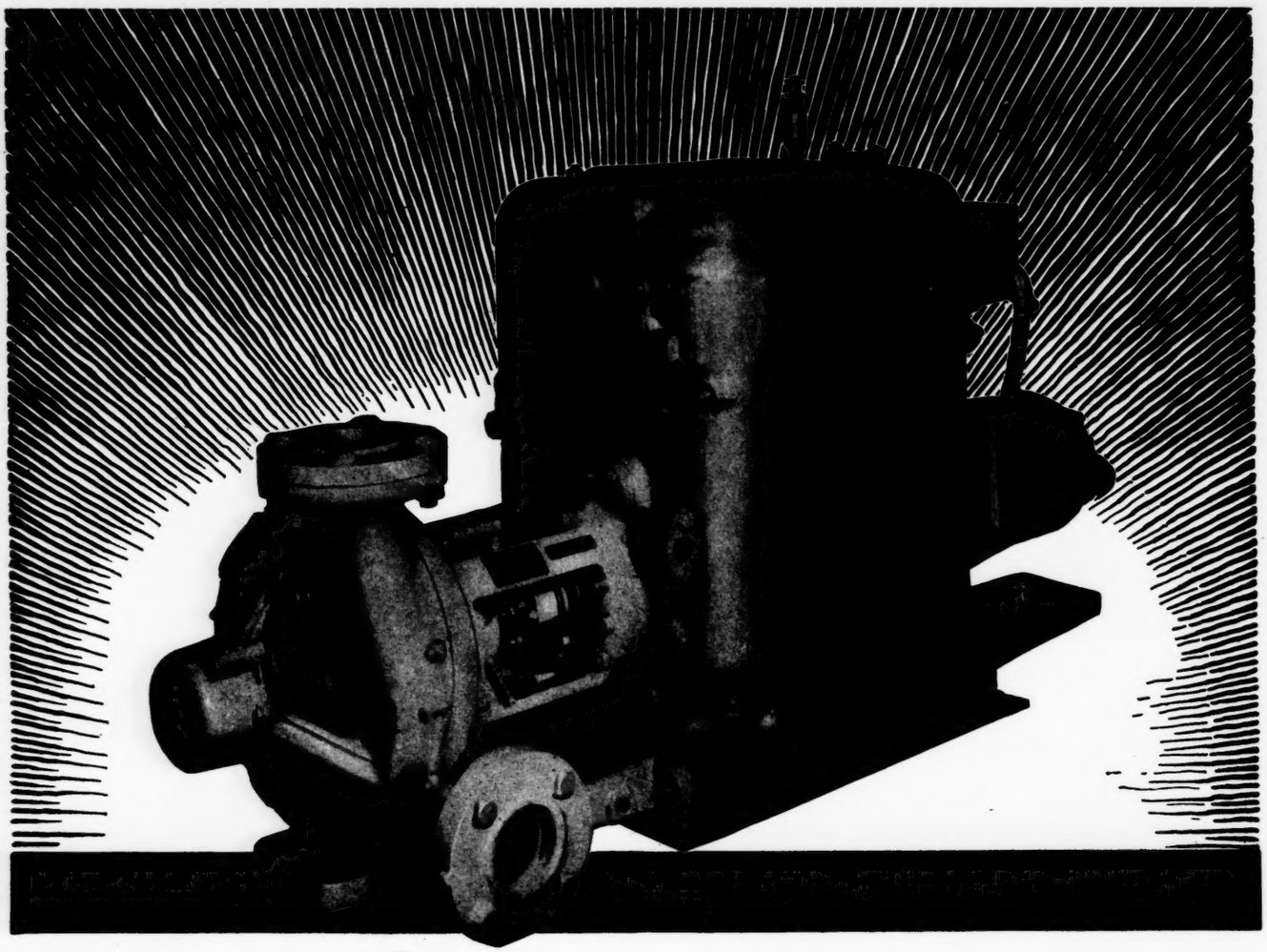
VOLUME 37 NUMBER 3

EDITORIAL STAFF

Editor
C. H. B. HOTCHKISS
Associate Editor
CLIFFORD STROCK
Assistant Editor
JOSEPH F. KERN, JR.

Safety!

THE NASH VAPOR TURBINE HEATING PUMP IS NOT STOPPED BY ELECTRIC CURRENT FAILURE



For service in greenhouses, hospitals, schools, theatres, and public buildings, where heat failure is a serious matter, the Nash Vapor Turbine Return Line Vacuum Heating pump should be specified, for this pump operates perfectly without electric current.

This is because the motive power is a special turbine operating on steam direct from the heating system. Steam used to drive the Vapor Turbine is returned to the system for heating, with little heat loss.

This pump insures constant heat in the system, it eliminates electric current cost, and it promotes high efficiency in the heating system. Heating efficiency is due to the fact that this pump can operate continuously with economy. Continuous operation means uniform circulation, and uniform conditions in the system mean steam saving.

This pump has but one moving part, no internal wearing parts, and requires no internal lubrication. Bulletin D-246 tells all about it, and it is free on request.

THE NASH ENGINEERING COMPANY

SOUTH NORWALK, CONNECTICUT, U. S. A.

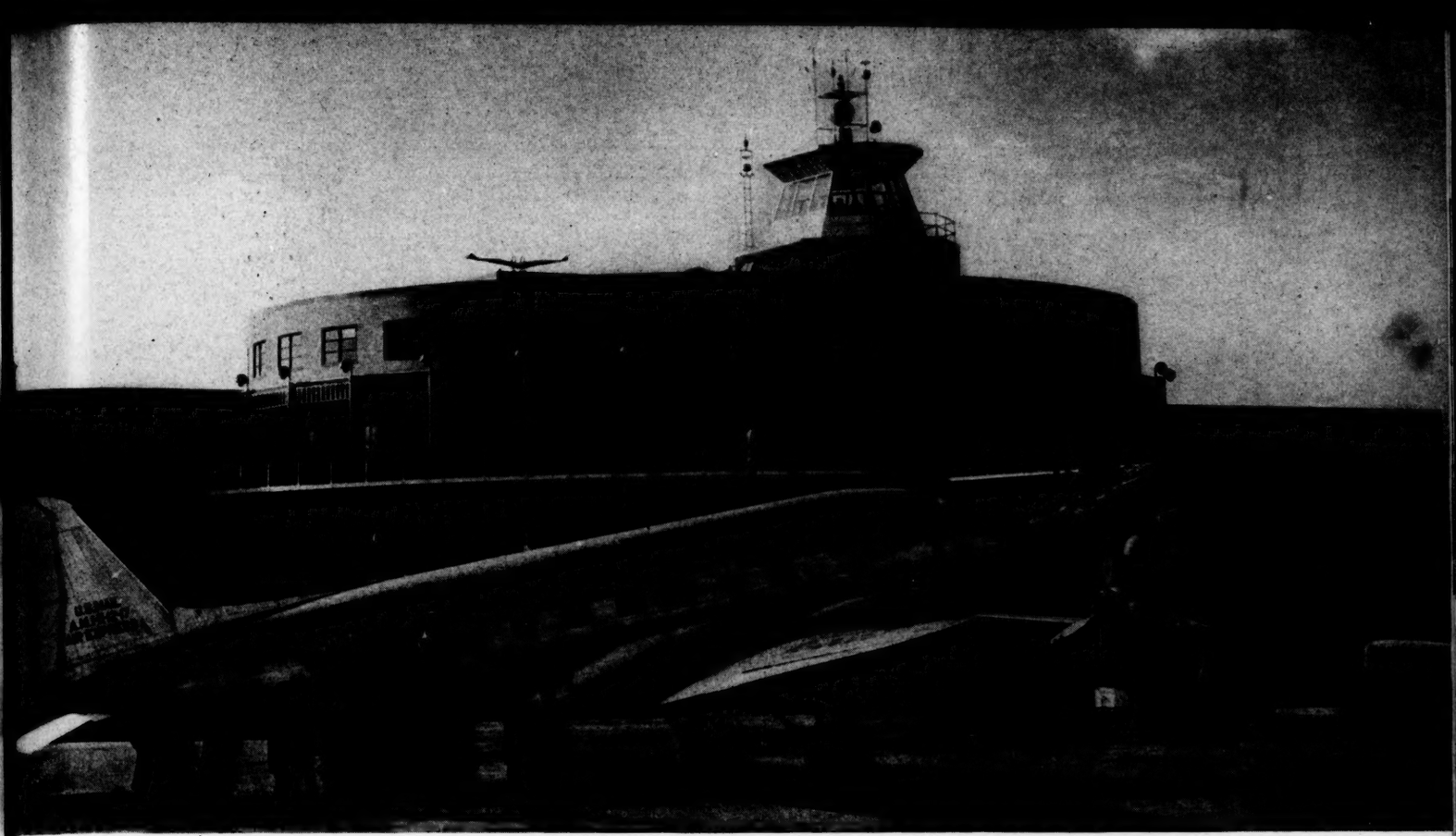


Fig. 1. Landplane Administration building from the loading apron.

Heating and Cooling the WORLD'S LARGEST AIRPORT

By MILTON C. HAMJE†

WITH seven spacious hangars and two administration buildings built on an ideally located tract of 558 acres, the City of New York's new LaGuardia Field is believed to be one of the world's finest airports, and is an outstanding example of concentrated planning and execution. Since the time when engineers and architects were commissioned to prepare working drawings, scarcely 2½ years will have elapsed before the completed project is turned over to the City's Administration.

Primarily, the airport is designed to accommodate transoceanic and transcontinental traffic. At the present time practically every airline serving New York City uses this field and early this spring at least one transoceanic line will use the seaplane base.

The largest part of the field is devoted to facilities for land planes. This section is located at the south side of the field and the buildings consist of 6 large hangars and an administration building. Hangars 1, 3, and 5 lie to the west of the administration building, hangars 2, 4 and 6 to the east, while on the field side is an elevated prominade deck for the convenience of the visitors. This prominade deck follows the path of the curve set by the hangars and extends from hangar 1 to hangar 2, a distance of 1500 ft.

Between adjoining hangars are wedge-shaped, 2-story buildings generally occupied by the airlines for maintenance purposes. In the building between hangars 3 and 5, however, is housed a city operated pumping station.

Attached to each of the land plane hangars is a 2-story building, a so-called *lean-to* accommodating general and executive offices, pilot training quarters, shops, lounges, stock rooms, kitchens, and employees' cafeterias. Engine test cells and engine repair shops are grouped in the 2-story west wing of hangar 5, as also are the propeller, paint, radio, welding and woodworking shops.

Each of these land plane hangars is 350 ft. wide, 165 ft. deep, and 42 ft. from the floor to the lower roof truss. Each has a door opening of 330 ft. x 42 ft.

The seaplane base is located at the west end of the field and consists of one mammoth hangar and the Marine Terminal building with Bowery Bay providing landing facilities. The seaplane hangar is a five-sided building with a total door opening of 670 ft. x 45 ft. or approximately 80% of the exposed wall area.

†Engineer, Office of Syska and Hennessy, Consulting Engineers, New York.

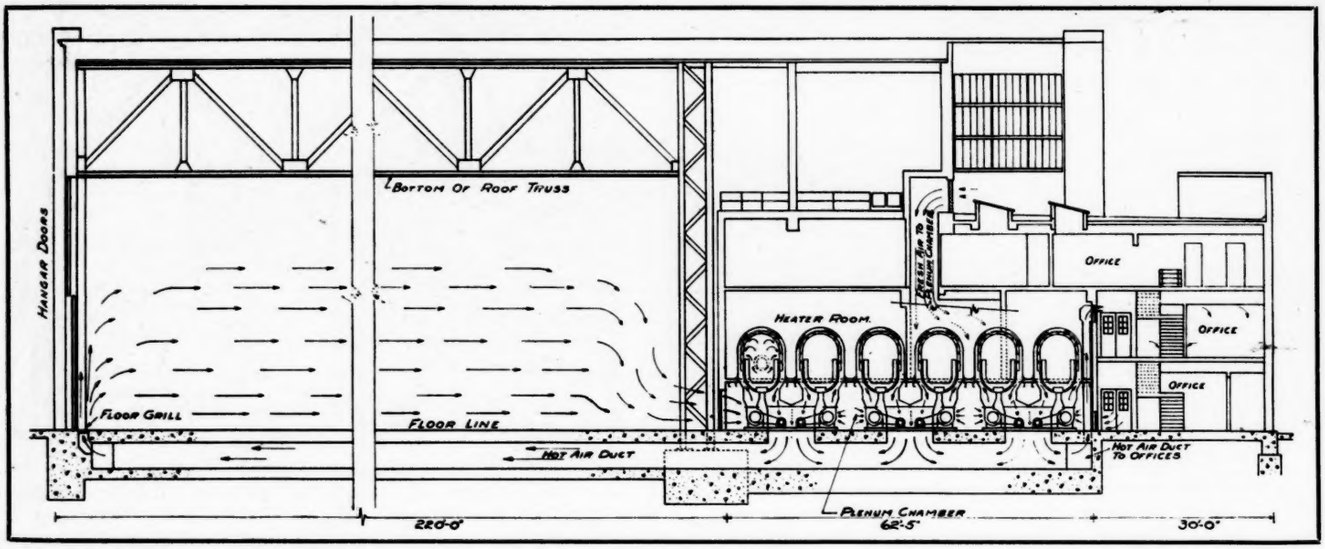


Fig. 2. Cross section of the seaplane hangar. Recirculated air is drawn into a plenum chamber where it is mixed with fresh air, then the mixture is forced over the heaters and through underground ducts to floor grilles near the hangar doors.

Heating Methods

The varying character of the several buildings produced inherent problems of heating, ventilating and air conditioning. The body of this paper will be devoted to a description of how these problems were solved.

The method of heating the hangars required extensive investigation with regard to such items as type of system, initial and maintenance cost, physical and architectural limitations, quick reheating and adaptability of equipment. For several reasons it was felt that a high pressure steam plant was not feasible. The various buildings are spread out over a large area and would, therefore, require extensive pipe trenches for steam distribution. As the ground is largely filled in, any trench work outside the buildings would require separate piling, the cost of which would be prohibitive. Furthermore, many difficulties were foreseen in the metering and billing for steam consumption.

After taking all of the factors into consideration, it was decided to install individual systems of forced hot air in the hangars and low pressure steam heating systems in the administration and maintenance buildings.

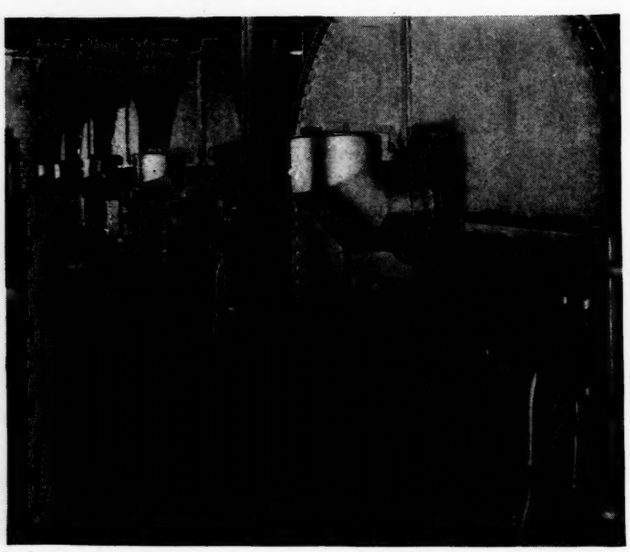


Fig. 3. Five of the six heaters used for heating the seaplane hangar. Heaters use No. 6 fuel oil and have a total capacity of approximately 20 million B.t.u. per hr.

Hangar Heating

In heating the hangars, outside air is brought in through a plenum chamber, mixed with the recirculated air from the hangars and offices, forced over furnaces and is then distributed to floor grilles near the hangar doors and to the duct-work serving the office space.

Essentially each hot air heater is a large unit heater consisting of an inner and outer shell. The inner shell serves as a combustion chamber and the outer shell as a container for the air to be heated. To increase the available heating surface, numerous fins have been welded to the corrugated inner shell. The moving air stream between the inner and outer shell not only carries the heat to the areas to be heated but also furnishes an efficient air jacket which restricts the radiation loss to 1%.

Each furnace is equipped with an oil burner designed for burning No. 6 oil. These burners are equipped with modulating controls capable of varying the output from 25 to 100%. Thermostats located in both supply and return air streams transmit the heating load requirements to the burners. Either the supply or return air thermostats may serve as a governing thermostat and when heat is called for, first the fans for the unit will be started and then through a time-delay device the first burner will start. As the load increases, successive units cut in. The burners shut down in the reverse order before the fans are cut out. Selector switches permit the reversal of the order in which the burners operate. It can thus be seen that the control system operates only enough burners to meet the load demand.

The heaters are set on a mezzanine. Operating in conjunction with and directly below each heater are two supply fans and one induced draft fan mounted on a common shaft driven by a 25 hp. motor. The induced-draft fan draws the flue gases through economizer tubes which serve to preheat the supply air and thus increase the efficiency of the unit. The supply fans draw the air

which is to be heated from a plenum chamber where the outside and recirculated air is mixed and discharges it over the corrugated steel shell of the combustion chamber. From the heater the air flows to connecting duct-work through underground trenches.

The heater and fan rooms are located at the center of the *lean-to* buildings and from each fan room four supply air trenches run to the exterior walls, two with branch ducts supplying floor outlets and two supplying a continuous plenum at the doors. The floor outlets are located at each wall bay, supply air horizontally and are equipped with adjustable louvers for regulation of air quantities. The plenum at the doors supply floor grilles which form a curtain of heated air across the entire door opening.

Recirculated air is drawn to the rear center of the building and reenters the fan chamber through bar grille openings at the floor level. Normally the system operates with 25% outside air and 75% return air; however, these proportions can be varied to any degree. In summer 100% outside air may be handled.

Keeping the supply and return air close to the floor reduces stratification to a minimum. Readings in preliminary tests taken at the height of 60 ft. indicate a rise of but a few degrees over the temperature maintained at the floor.

The *lean-to* buildings for hangars 2, 4, 6, and the seaplane hangar are also heated with hot air. Booster fans draw the heated air from the main system, mix it with outside air, and force it to the individual rooms through a system of duct-work. Recirculated air from these rooms is returned to the main system.

The hangar heating systems are capable of restoring the design temperature of 55F within 24 minutes after the doors are closed. There are 4 heaters supplying a total of 135,000 c.f.m. for each of the landplane hangars and 6 heaters delivering a total of 210,000 c.f.m. for the seaplane hangar. Each heater is designed to deliver 3,150,000 B.t.u. per hr. while operating at 85% efficiency. Temperatures are maintained in the offices at 70F and in the shops at 65F.

Fig. 4. Seaplane hangar fan room which is located directly beneath the heater room. These fans are used to force the air from the mixing chamber through the heating units to the underground trenches which distribute the air.

Each hangar has a separate oil tank with a capacity of 15,000 gal. Hot water circulating through heating coils in the tank maintains the proper flow conditions.

It was mentioned previously that the *lean-to* buildings of hangars 2, 4, and 6 are heated with hot air from the main heating system. This procedure was not followed in heating the *lean-to* buildings of 1, 3, and 5, inasmuch as the tenant, American Air Lines, desired to use these buildings for their home office. To meet its needs the *lean-to* buildings were increased in size, and both offices and shops were completely air conditioned for both summer and winter use.

Two 42,500 sq. ft. oil burning boilers were installed in hangar 5 to supply steam to the various buildings occupied by this company and steam mains were run from the boilers to the various buildings. From the main machinery room of each hangar, the steam is distributed to the air conditioners and radiators. In most cases the condensate return mains in the individual

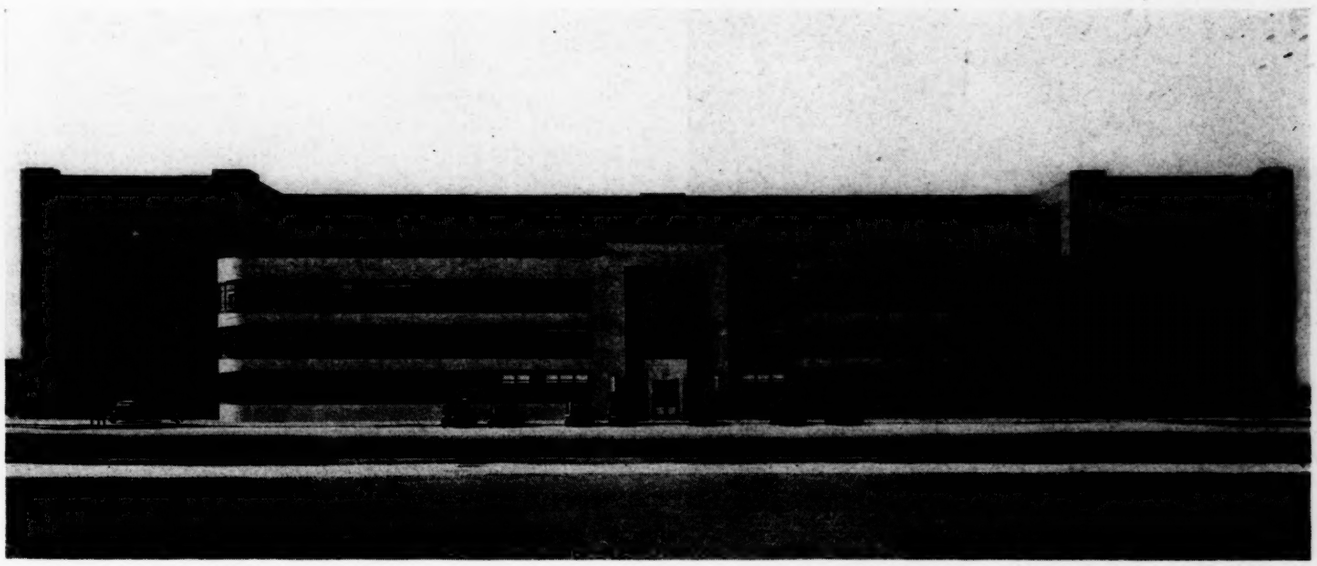


Fig. 5. Seaplane hangar which is the largest of the seven hangars at LaGuardia Field. Approximately 80% of the outer wall surface is made up of doors. The total volume of this building is 6 million cu. ft.

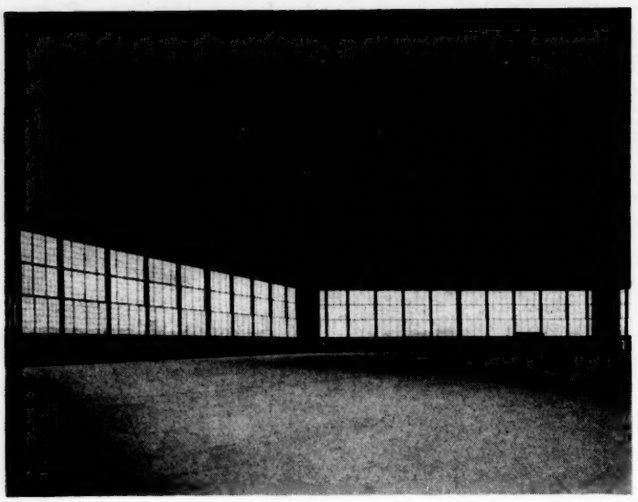


Fig. 6. Interior of seaplane hangar. Floor area is large enough to accommodate two full size football gridirons. Manhole in floor at lower left provides access to volume control dampers in warm air ducts below.

buildings are run at the first floor level to their respective vacuum return pumps. These pumps discharge to a receiving tank in hangar 5 from which the feed pumps return the condensate as required.

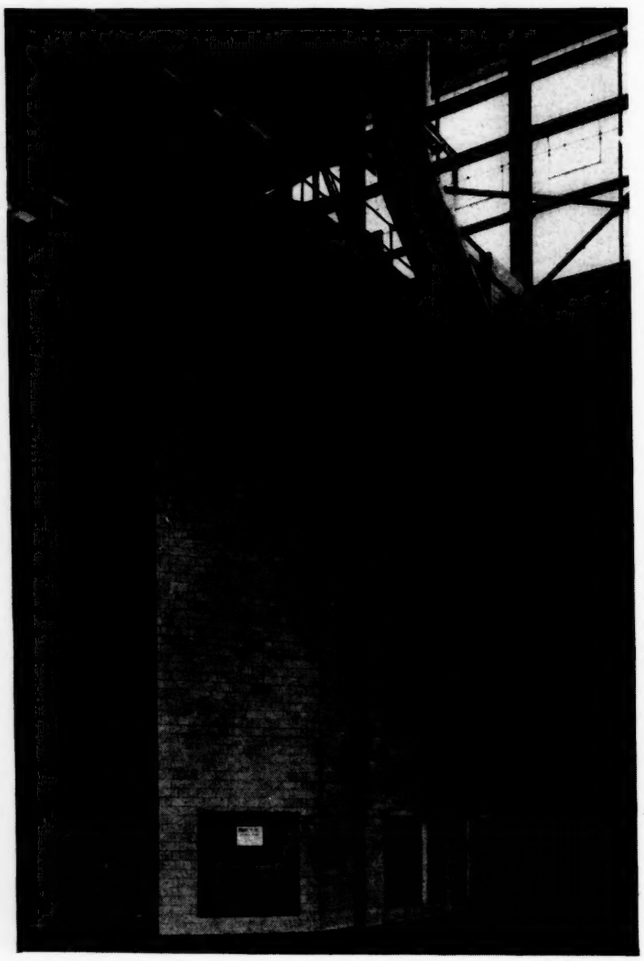


Fig. 7. Exterior of heater room in seaplane hangar. Return air openings can be seen near the floor. At the right is a breeching connection to the chimney from the steam boilers located in this building which are used to heat the Marine Terminal building.

Since the chimney heights were limited so as not to create obstructions, induced draft fans were provided for each boiler to operate in conjunction with the burners.

Air conditioning, in both shops and offices, is accomplished by means of 22 unit air conditioners employing chilled water during the summer and humidification and tempering stacks during the winter. The air conditioning units are so located as to segregate or zone the various rooms according to the number of hours of use and exposure.

There are two refrigerating plants supplying chilled water to the air conditioning units. One plant consists of four 50-ton compressors, two shell and tube water coolers, four evaporative condensers and four 200 gal. per min. 158 ft. head, 15 hp. chilled water circulating pumps. This plant is located in hangar 5 and serves the units located in hangars 1, 3, and 5 and the interconnecting buildings between hangars 1 and 3.

The second plant serves the shop spaces in the west wing and consists of two 50-ton compressors, a shell and tube water cooler, two evaporative condensers and two 125 gal. per min. 125 ft. head, 10 hp. chilled water circulating pumps. A loop connecting the two chilled water systems has been installed as an emergency cross connection.

Air Conditioning Control

The control for the air conditioners is such that the units admit a predetermined percentage of outside air for ventilating with provision for automatically increasing the amount of outside air and reducing the amount of recirculated air when the outside temperature conditions permit. A humidistat located in the return air stream maintains the proper relative humidity during the winter season by regulating the supply of hot water to the humidifier sprays. This humidistat is controlled by a thermostat in the outside air intake to compensate for varying outdoor conditions and to prevent the formation of moisture on windows. A modulating steam valve on the heating coils is operated by thermostat in the return air duct. A low limit thermostat in the supply prevents the temperature from falling below a predetermined adjustable temperature setting. A safety thermostat in the inlet side of the conditioners will close the fresh air dampers should the return air fall below 40F. For summer operation a thermostat in the fresh air intake controls a thermostat in the return air to operate in the three-way valve on the chilled water supply to the cooling coils.

Maintenance Buildings

The wedge-shape buildings connecting hangars 2—4 and 4—6 are used for shops, maintenance offices, stock rooms, test cells and garages. A city garage on the field side of the building between hangars 2 and 4 is used to house field emergency equipment. In the center of the same building are engine test cells shared by United Airlines and Transcontinental and Western Airlines, the occupants of hangars 2, 4, and 6. Each of these buildings has its own steam heating system of the two-pipe, vacuum return type. The boiler for the building between hangars 2 and 4 is of 3000 sq. ft. capacity and that for the second building is of 10,000 sq. ft. capacity. Each uses No. 5 oil.

The pumping station located between hangars 3 and 5 is of the utmost importance for the protection of the airport since here are housed the fire department's high pressure pumps and storage tanks. The heating of this building is accomplished by unit heaters located to protect all vital points. The system is of the one-pipe type with wet returns using an 1800 sq. ft boiler equipped for burning No. 3 oil. Each unit heater motor is controlled by a separate electric thermostat while reverse-acting pressurestats in the steam connections to the unit heaters prevent any fan motor from starting until the preset steam pressure is attained. A relay in each unit control circuit causes the oil burner to operate under pressure control when any thermostat calls for heat and only when all thermostats are satisfied is the oil burner permitted to stop. The temperature maintained is 45F. A separate thermostat is arranged to sound an electric horn to summon attendants should the temperature, for any reason, fall below 35F. If the burner should fail, steam can be obtained from the main steam line supplying hangars 1, 3, and 5. A valved cross connection has been installed for this purpose.

Land Plane Administration Building

The land plane administration building is the focal point of the airport. Circular in shape and with two wings running east and west, the building contains all the conveniences and necessities generally associated with modern air travel.

The ground floor is given over to express and baggage handling spaces, a post office, first-aid and doctors' quarters, and employees' locker rooms. On the first floor center are telegraph offices, concessions, ticket booths and passenger lounges. A coffee shop is in the east wing and in the west wing is a suite of offices which houses the airport management. The main dining room on the second floor takes the shape of an inverted *U*. This room faces the field and opens out on a terrace. Adjoining in the east wing is the restaurant kitchen. In the west wing is a private dining room and also a cocktail lounge appropriately named *Kitty Hawk Room.*

Third floor offices are set aside for the U. S. Weather bureau, communications and traffic-control spaces for the Civil Aeronautics Authority. On the roof and toward the field is the control tower which has been termed the *nerve center* of the airport. Contained in the tower is a miniature reproduction of the field which electrically indicates, and assists to control, the lighting and position of traffic on the field. Pilots are kept in close communication by radio with the control tower to aid them in take-offs and landings.

Throughout, the building is heated by direct radiation thermostatically controlled. In the basement are located two 30,000 sq. ft. oil fired low pressure heating boilers with vacuum return pumps, also two 10 hp. gas fired high pressure boilers supplying steam to dish washers in the restaurant kitchen.

Air conditioned spaces, excepting the control tower, have direct radiation to offset transmission losses. Public spaces are ventilated by supply and exhaust systems. Under the motor car ramp leading to the main entrance on the first floor, is located the supply fan for the rotunda. Air is supplied at the ground and first floor levels of the rotunda and extracted through the glass dome on the roof. The second floor main dining room, toilet rooms, and interior spaces are ventilated by separate fans located in a roof fan room over the front section of the building.

The east wing of the first floor and west wing of the second floor, originally intended for general offices, were recently leased and altered to accommodate a coffee shop, a private dining room, and the *Kitty Hawk Room.* Because of space limitations central fan systems could not be provided. In ventilating the coffee shop this obstacle was effectively overcome by installing unit ventilators on the north and south sides of the room. To the east end of the room is an exposed kitchen and the room is exhausted through the kitchen system.

The private dining room and *Kitty Hawk Room* are air conditioned by a system of units. Two 5-ton self-contained units, set in false piers on the west wall of the *Kitty Hawk Room,* are designed for 100% recirculation. A third unit located in an adjacent equipment

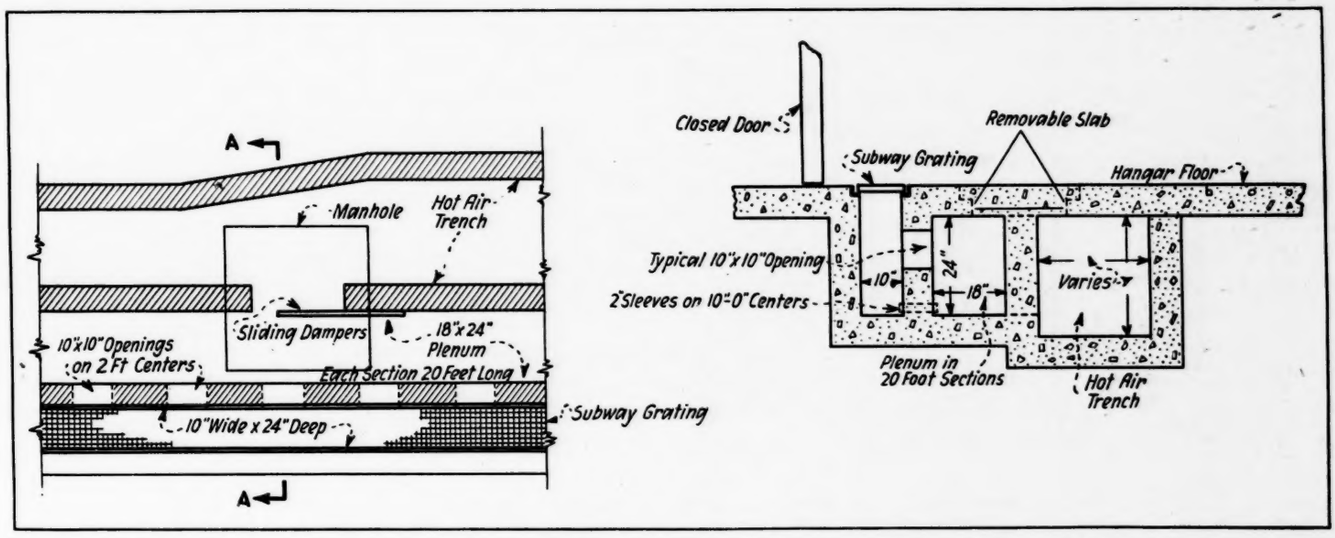


Fig. 8. A detail of the underground supply air trenches at the door openings. Floor gratings distribute warm air and produce a warm air curtain at each door.

room and operating in conjunction with a 15-ton condensing unit, supplies 100% fresh air. To raise the outlet temperature the air conditioning unit employs a special reheat coil for summer operation. The room is exhausted through specially designed lighting fixtures by duplicate fans set on the low roof above. Smoke is intermittently removed from the room by employing a third fan to act in unison with the two exhausters. Controls for conditioners and fans are interlocked and provide full automatic operation.

For the private dining room, a 5-ton self-contained air conditioner has been installed. The straight exhaust and smoke exhaust are combined in one system. During normal operation the quantity of air exhausted is controlled by automatic dampers; in purging the room of smoke the dampers open fully. When the room is cleared the conditioner starts up once again and the exhaust dampers resume their previous setting.

The control tower takes the shape of an elongated octagon. From the tower a commanding view of the field may be had in all directions through continuous window sash on all sides of the structure.

At a level below the tower is a machinery room in which are located a unit air conditioner and a 5-ton water cooled compressor. In the tower above, a continuous steel enclosure, sill high, parallels the outside walls. Within the enclosure are supply and return ducts. Outlet grilles in the sill supply a blanket of air at each window while returns are taken from the sides of the enclosure at the floor.

Beneath the promenade in front of the land plane administration is a loading platform to which the planes are brought for the convenience of arriving or departing passengers. The field side of the platform is enclosed by steel and glass panels. Along the platform are fourteen dispatchers' booths representing the various airlines. Dispatchers forward last-minute communications to the pilots and check plane accommodations. Each booth is heated by a free standing gas heater employing forced circulation. These heaters have an hourly input rating of 40,000 B.t.u. and are equipped with humidifier pans. A safety pilot control prevents gas from being supplied unless the fan is operating. Thermostats control the fan motors.

The Marine Terminal is a three story building with two 2-story wings. This building is steam heated by a two-pipe vacuum return system. In keeping with the architectural treatment, a large number of recessed convectors are used. Because of space limitations, two 12,200 sq. ft. steel heating boilers have been located in the seaplane hangar some 400 feet away. A trench containing the steam and vacuum pump discharge lines links the two buildings. The vacuum pumps and hot water generator are located in a first floor machinery room of the terminal. Supply and exhaust ventilation has been provided for passenger and baggage spaces and for the rotunda.

Acceptance tests have recently been concluded on the six hot air heaters installed in the seaplane hangar. Insofar as possible the test was conducted in accordance with the Power Test Code of the A.S.M.E. Engineers of the New York Testing Laboratory analyzed the flue gases and calibrated the instruments. The tests were witnessed and readings taken by New York City Engineers. A tabulated comparison of guarantees and test results for each heater is as follows:

PERFORMANCE OF SEAPLANE HANGAR HEATING UNITS

Item	Results Guaranteed	Test Results
B.t.u. per hr. output	3,150,000	3,260,000
Efficiency—per cent	85	86.68
CO_2—per cent	13	13.42
CO—per cent	—	0.0
Radiation Loss—per cent	1.0 max.	0.78
Flue Gas Temperature	375 to 400F	389F

Because this was a pioneer installation the specified test requirements were severe. Upon inspection at the conclusion of the test no distortion, leakage, or warping was observed. From a design standpoint the heaters presented an interesting problem as they were twice as large as any similar units previously built. It was necessary to predict results on the basis of transfer coefficients obtained from the smaller units.

Delano and Aldrich, the architects, were responsible for the design of the buildings. Syska and Hennessy were retained as consulting engineers. The Works Progress Administration erected all the buildings and made the complete mechanical installation.

The entire construction was done under the direction of the engineers of the Department of Docks, which Department under city charter is charged with operation of all city airports.

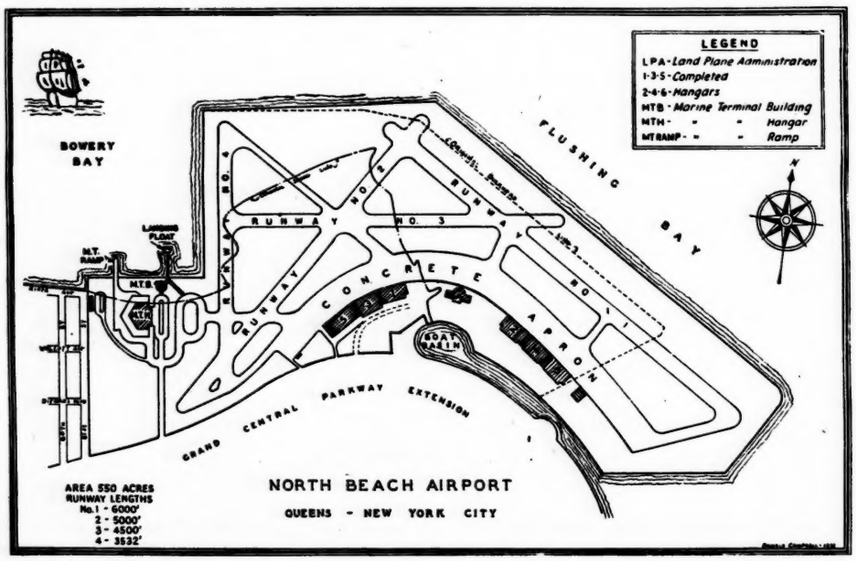


Fig. 9. Plan of the LaGuardia airport, North Beach, New York. Shaded area to left of hangar 5 is the west wing which houses various maintenance shops. Between hangars 3 and 5 is the fire department high pressure pumping station, while between hangars 2, 4, and 6 are located airline maintenance buildings.

Chemical Conditioning for Customers' Comfort

By LESTER T. AVERY†

THE Crosbys wanted something better! No, they weren't hypercritical nor did they pretend to know all the answers. They did know the restaurant business and had been making a success of that for years. Here was their dream come true, a fine new restaurant in the location they wanted, plenty of parking space, and room to properly serve their trade.

In 1933 they installed summer air conditioning in their restaurant on Euclid Avenue, this being one of the first restaurants in Cleveland so equipped. Crosby's serve a family trade—no liquor—and they have been crowded for lunch and dinner, people standing a half hour or more to wait for seats, but they stood and waited for the food was extra good. During six years Mr. and Mrs. Crosby had every opportunity to weigh the value of summer air conditioning and when the new restaurant to seat 400 was being planned Mr. Crosby said, "Of course we have to have it, couldn't think of getting along without it. But we must do it better. Better than our old system, that was good enough at the time I bought it six years ago. I want the new restaurant to have plenty of air for ventilation so it won't smell, and I want dry air, not too cold. And we want to be careful about drafts as most people object to them."

Experience is a great teacher. Standards of air conditioning are being constantly improved by the insistence of the buyer and the public that this business of air handling be more nearly perfect. Twelve million dollars worth of air conditioning work in public buildings in Washington was turned down for appropriation because the committee was critical of results secured in some of the installations made in old buildings. Instead of recognizing that this work can be done better—as Crosby did—this committee took the position that it was not practical. Odors, draft, and control are the particular points that have to be watched most carefully to assure good results. The *American Medical Association Journal* suggests that higher temperatures should be carried to prevent shock in hot weather.

All of these refinements cost extra money, as compared with the elementary system so common in commercial work. Mr. and Mrs. Crosby knew this and they were willing to spend the additional sum necessary to get the result they desired. After very careful investigation they decided to install a combination system whereby the dehumidifying would be done chemically under its own control, and the cooling would be done with refrigeration under entirely separate control. They agreed to 7,500 c.f.m. outside air for 400 people, a very liberal allowance, and they insisted on a good air distribution arrangement to minimize the possibility of drafts.

The work was done under the direction of the Austin Company, owners of the building and general contractors and engineers for the alteration work. The main floor has large windows on the south and west sides. The front half of the main floor is 16 ft. high, air for this section being supplied from grilles on the front edge of the balcony. The balcony divides the height so that space under the balcony and on the balcony proper has an 8 ft. ceiling height. Ceiling rosette type air supply fittings are used here for air distribution, so arranged on the balcony that accordion partitions can divide this space into five private dining rooms, each with its own air distribution. The draft problem seems to be pretty well solved.

The air conditioning unit handles 11,000 c.f.m. of which 7,500 c.f.m. is outside air and 3,500 c.f.m. recircu-

†Avery Engineering Co., Cleveland, Ohio.

lated. The excess supply air that does not leak out the restaurant doors is vented to the kitchen which has its own supply and exhaust air system. This helps out the working space to a certain extent as approximately 5,500 c.f.m. is drawn from the dining room through the kitchen to the kitchen exhaust fans.

Cleveland design standards call for 95F D.B., 75F W.B., as outside air conditions and the restaurant inside condition was designed for 82F D.B., 66.8F W.B., 45% relative humidity, 75F effective temperature. It appeared from observation of other installations, and since confirmed in this one, that most people prefer the slightly higher temperatures and lower relative humidities, and 75F effective temperature is not too cold for any healthy person, although a few might prefer a little lower temperature. So much criticism during the past few years has come from overcooling, particularly in trains and theatres, that it now seems wise to control on the top of the comfort zone even at the risk of displeasing a few who would say this was a little too warm. The low relative humidity with adequate air motion apparently dries everyone slowly but effectively. The arrangement of control on this system holds a constant moisture content of entering air at 60 grains, and there is small variation in room relative humidity with the variation in the people. The temperature control also varies between 78F when all cooling is off, and 82F when the machine is on 100% so that this likewise affects the relative humidity. The actual variation is, however, very slight, 40% to 50% R.H., 78F to 82F D.B., 72F to 75F effective temperature, and the lower temperatures come only on those days when the outside air is relatively cool, say 80F D.B., 70F W.B. Thus without any elaborate control mechanism the system adjusts itself readily to the changes in outside weather and provides a condition pleasing to so many that Crosbys say that they have had "Nothing but compliments on the air conditioning."

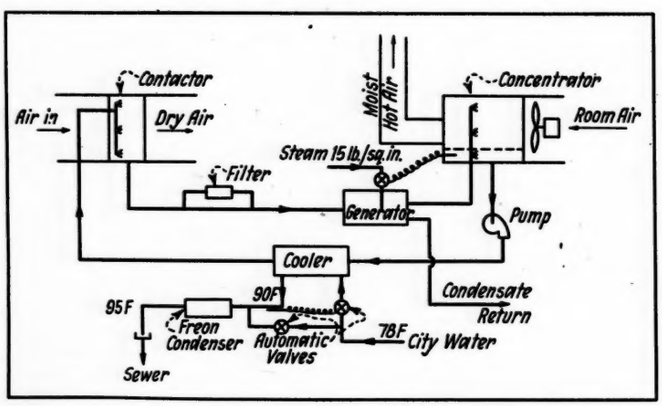
Fig. 2 shows the circuit of air through the dehumidifying and cooling equipment. 7,500 cu. ft. of outside air at 95F D.B., 75F W.B., is filtered and passes through the contactor coming out at 98F D.B., 53 grains per pound of dry air. This delivery is constant no matter what the entering air condition may be and it is held so by keeping the temperature and specific gravity of the dehumidifying liquid constant. The temperature of the Kathene is maintained by automatic control of city water which leaves the cooler at 90F, 80 gal. per min. required for full load conditions when the entering water is 78F. The specific gravity is maintained by automatic control of steam to the concentrator, 720 lbs. per hour required for full load. Thus the greater the dehumidifying load the weaker the solution, requiring more steam for boiling out the water and more city water for cooling the solution. Under light loads the steam and water throttle off.

This dry warm air is then mixed with the recirculated air, 3,500 c.f.m. at 82F D.B., 66.8F W.B. which results in a mixture at 93F D.B., 67.3F W.B., 60 grains per pound of dry air going to the direct expansion cooling coils. These are connected to a 25 hp. dichlorodifluoromethane compressor with 50% load control, operated by two-point thermostat in return air duct. Under full load the air leaves the cooling coil at 66F D.B., 58F W.B., 53F dewpoint and passes to the restaurant where it absorbs the heat and moisture of the room and results in the design condition of 82F D.B., 66.8F W.B.

The warm water (90F) leaving the Kathene cooler is passed to the condenser, thus conserving the use of purchased city water. As a further operating economy the dampers are arranged so that between hours of peak load the recirculated air is passed through the contactor and the outside air cut down to 4,000 c.f.m. This serves the restaurant at a minimum operating rate except for the lunch and dinner peaks, each about two and one-half hours, when the system is automatically placed in 100% operation.

Besides the 25 hp. compressor motor there is a ½ hp. motor on the fan for the Kathene concentrator and a 5 hp. motor on the Kathene pump. The steam is generated in a gas boiler. It is thus interesting to observe, Fig. 1, how the combination of gas for generating steam, power for compressor, fan and pump motors, develop the energy to change the state of the air in temperature and humidity for air conditioning. The heat is eventually dissipated to the sewer through the city water and the moisture is driven off the Kathene solution by air blown through the concentrator and vented to the roof.

In spite of the fact that Crosby's more than doubled their seating capacity in the new restaurant the customers are still standing. They offer food only—no liquor—and they are proving that good food, good service, and attractive surroundings will bring and hold restaurant patrons.



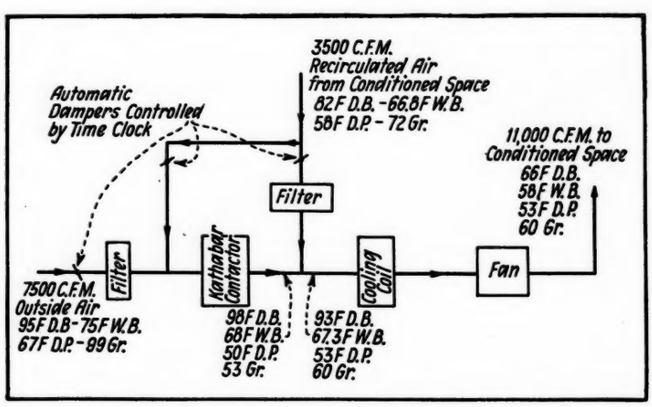
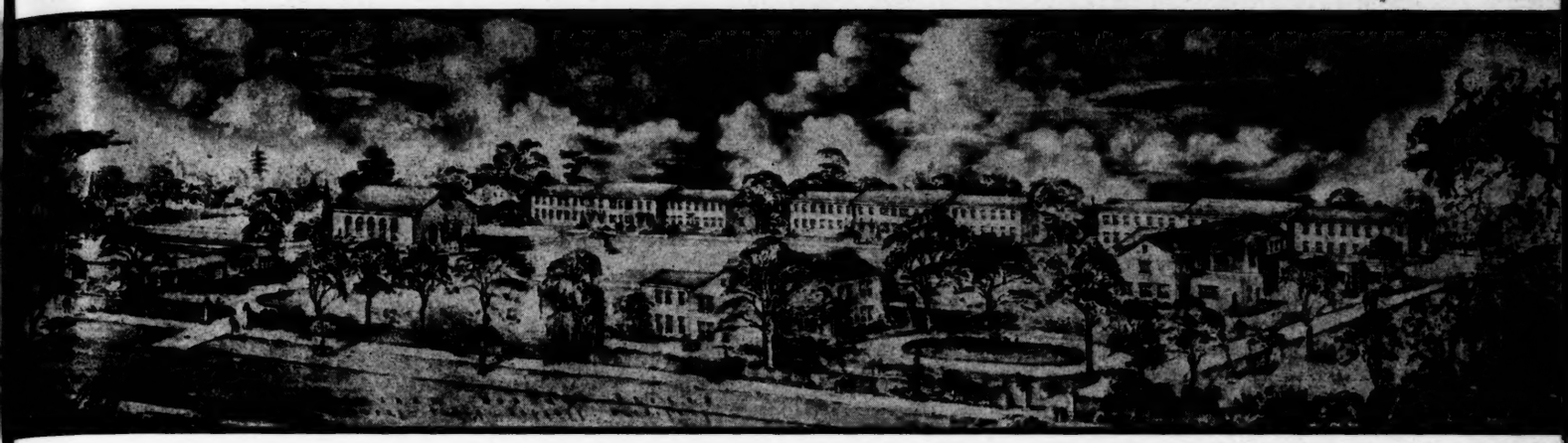


Fig. 1. (left) Arrangement of equipment for drying the air. Note that the city water first cools the dehumidifying liquid and then the refrigerant. Fig. 2. (right) Flow of air through dehumidifying and air conditioning equipment.



Heating a Modern Cottage Type Prison

By TELFORD R. DAVIS†

Modern prisons incorporate many features designed to provide better control of the prisoners while at the same time providing conditions which are favorable to helping the prisoner gain a useful place in society. Heating practice in this type of building differs from practice in other structures in that all equipment located in prisoners' quarters must be designed to prevent tampering and must be under the control of a central station. In this article the author describes the system installed in the new group "Cottage System" buildings at the Indiana Women's Prison, Indianapolis, Indiana.

IN the year 1869 the legislature of the State of Indiana appropriated money for, and authorized the construction of a reformatory for women and girls. This institution was not completed until 1873 when additional money was granted. The first prison population consisted of seventeen women.

The prison property is located in a thickly populated residential district of East Indianapolis, and the site comprises some fifteen acres of area. The original prison consisted of a large single brick building built about the middle of the past century.

The prison population has been increasing through the years and from time to time additions to the original building have been made. The present population now averages about two hundred and twenty-five women.

Last fall the final construction work was completed on a new group of buildings, built entirely around the old building. The old building is now being demolished. The consulting engineer for the present group of buildings was Charles R. Ammerman while the architect was Robert Frost Daggett.

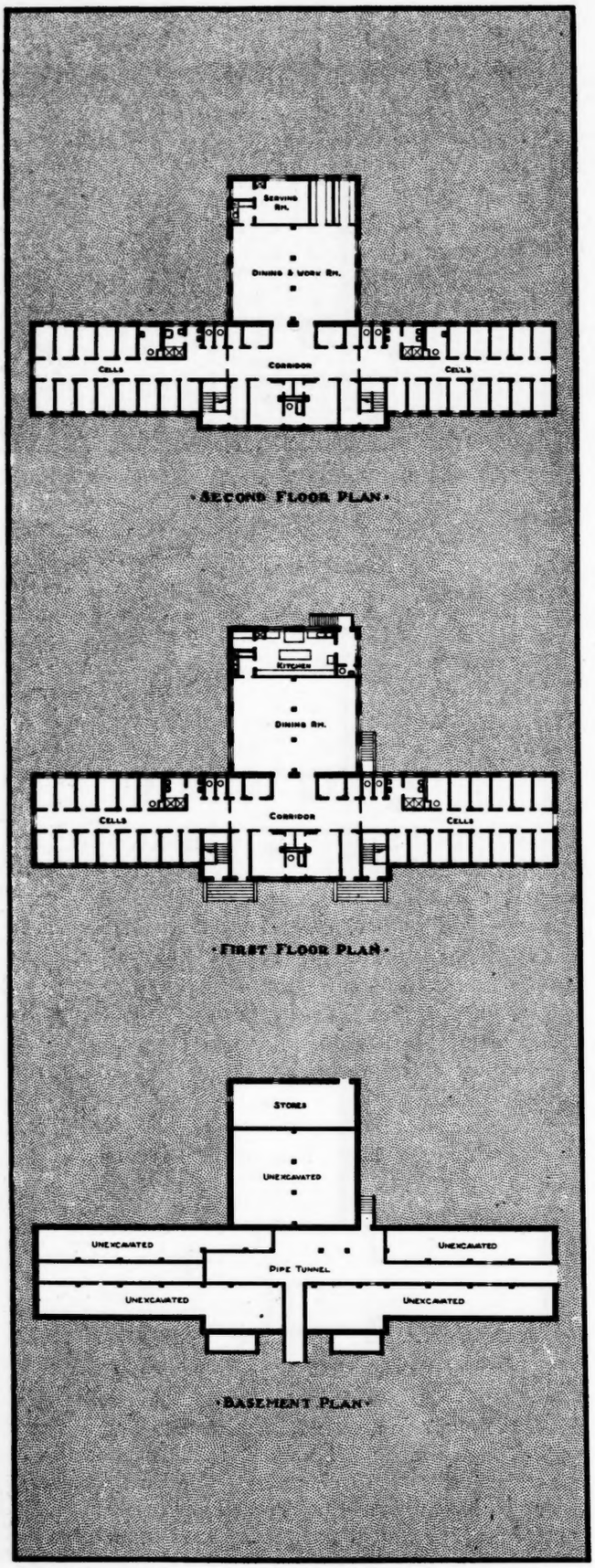
The new prison group is known under modern prison terminology as the *Cottage System*, providing better control and segregation of the two main prisoner groups known as *Correctional*, and *Penal*. This new group comprises some seven separate buildings. The various buildings comprising the group are classified as follows:

1. *The Administration Building*: This building houses the Superintendent's office and living quarters and quarters for Superintendent's Assistants.

2. *The Hospital Building*: This building contains the clinics for the prison medical inspection and treatments of inmates and contains several cell blocks for housing new women during which time treatments as needed are administered, and new inmates are placed under medical observation.

3. *Cottage Buildings*: These are the buildings which house the regular prisoners. Each cottage is two stories high. The accompanying floor plans indicate the various arrangements of cell blocks, attendants' quarters, dining rooms and kitchen. The basement of each building forms a section of an underground tunnel system which connects each of the seven buildings. It is in these tunnels that all service pipes, with the exception of cold water lines, are installed, serving each respective building with steam for heating and hot water service. It is to be noticed by perusal of the floor plans that access to the tunnels is not provided except from out-

†Office of Charles R. Ammerman, Consulting Engineer, Indianapolis, Indiana.



Floor plan of typical cottage building. Each cottage is two stories high. The basement of each building forms a section of an underground tunnel system which connects each of the seven buildings. All service pipes are run through these tunnels. It will be noticed that access to the tunnels or to any of the floors must be made through outside doors.

side doors, making it impossible for anyone to escape directly from cells or building and hide out. Again it is impossible to go from one floor to another except by leaving building and re-entering another entry.

Each cottage contains its own kitchen for the preparation of meals. All meals are served in the individual cottages.

4. *Chapel*: This is a dual purpose building. The first floor is equipped as a chapel wherein religious services are held for prisoners. The basement of this building is used as a stores department. Here canned goods and various supplies are stored. It is here also where all bread is baked. A coke oven is provided for this purpose. A ramp provided at rear of the building allows trucks to unload directly at store room level.

5. *Heating Plant and Laundry Building*: This building houses the steam boilers and water treatment and heating equipment. The prison laundry, carpenter shop and canning rooms also occupy portions of this same building.

Three 150 hp. horizontal return tubular boilers operated at 100 lbs. steam pressure provide all steam required for heating purposes and the heating of hot water, and also provides steam for laundry and canning departments. Auxiliary equipment consists of water softeners and deaerating feed water heater and sulphate boiler water treatment and feed pumps.

A sixty-pound pressure steam line distributes throughout the tunnel system. At each cottage basement, a reduced pressure connection is made into a distribution heating header. Each cottage, for the sake of heat control, was proportioned into zones. A typical cottage was zoned into six sections; for instance a North East cell block, a North West cell block, a South East cell block, and South West cell block, a kitchen and serving room section, and the living quarters for attendants. The zone system used is one in which a particular radiator temperature is maintained for a corresponding outside condition. The controlling or pilot radiator in all cases was placed in a location such as a corridor or open work space to preclude the possibility of a prisoner tampering with control instruments as might be the case if same were located in a cell. The attendants' living quarters although provided with a separate valved branch from the distribution heater is not controlled by a single zone thermostat and valve, but instead each room is provided with a separate room thermostat to provide individual comfort conditions to which the attendants are entitled. The zone control panel containing pneumatic switches for control conditions in any particular zone is located in an open corridor outside barred cell blocks and is under lock and key and entirely supervised by the floor attendant.

As each individual cell is provided with a pivoted outside window ventilator, no other cell ventilation is needed or provided for. Shower rooms, toilet rooms, and kitchens, however, are provided with mechanical ventilation.

All hot water is heated at the boiler plant and distributed through the tunnel by a complete recirculation system. A hot water pump is provided at the boiler room. Each building, however, is provided with a small

booster heater to make up for tunnel line loss. All hot water is softened.

In the basement pipe space of each building is installed two water headers; one connected to city water line, and the other connected to well water line. Each main water branch to the various sections of the prison is separately valved and cross-connected at the headers. A special approved check valve arrangement is provided in a city water meter pit to prevent well water flowing into city mains wherever well water is opened into regular water piping.

Drinking water foundations and cold water faucets at kitchen sinks are at all times connected into the well water system. A deep well turbine unit, located in separate turbine room near heating plant, supplies the well water system. Water temperature from this well averages 55F and is delivered from a depth of four hundred feet. The deep well water system also has sufficient capacity to provide for all garden sprinkling.

The emergency cross connected water headers were provided for supplying the well water in case of city water main failure, or vice versa. Both the city water supply mains and well water mains were constructed of cast iron pipe and installed parallel below grade.

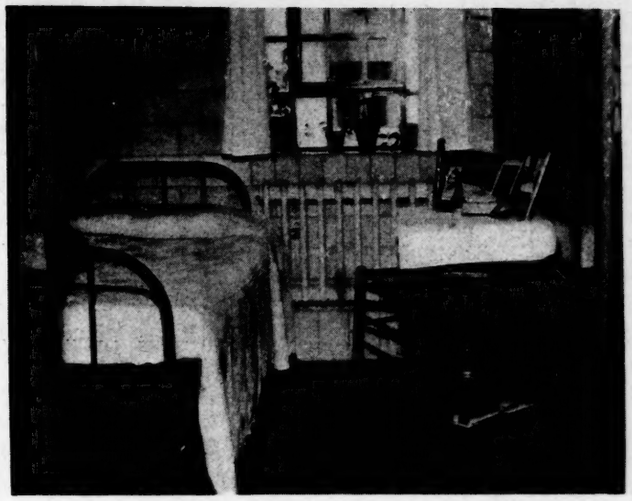
Each cottage is provided with gas service for use in kitchens. One gas meter pit, outside below grade, was provided and from this point a gas main was installed underground and distributes to the various buildings.

Electrical energy for light and power is 120/208 volts distributing through the tunnel system from the main panels located at the heating plant. All current is supplied by the local power company.

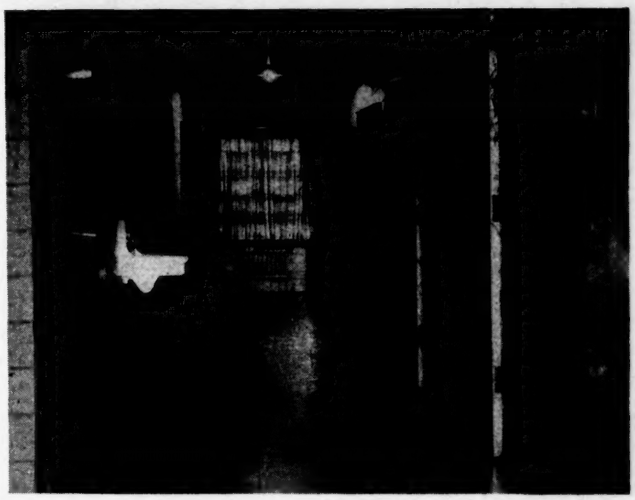
Quite an elaborate system of inter-communication between the Superintendent's office and the outlying buildings has been provided. This system incorporates several features not usually found in institutions of this size and character. A master communication station has been provided in the Administrative office through which the Superintendent may talk collectively or individually to each sub-station located at strategical points in the various buildings. Audio amplification is provided for normal conversation between stations. This provision makes it possible for the Superintendent, without knowledge of inmates or attendants, to listen in or *snoop* as the term is used, and also to detect riots or unusual disturbances immediately.

The architects and consulting engineer were given splendid cooperation by the present Superintendent, Mrs. Marian F. Gallup, which resulted in incorporating the many features so important in prison administration.

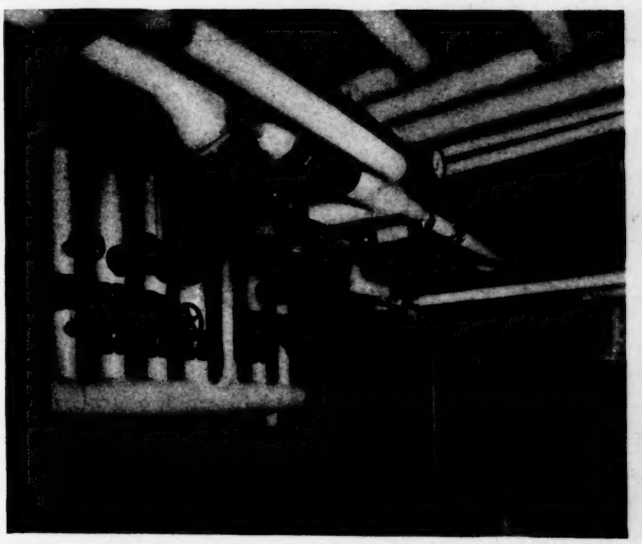
The building program was carried out in two distinct operations. The first part of which included the construction of the Hospital and Administration Building and two of the cottages. This part was paid for solely out of State funds. The second part of the building program, and now completed, consisted in the construction of the remaining third cottage, the chapel building, and the heating plant and laundry. This last section of the building program was carried on with the aid of a government grant through P.W.A. The total cost of all construction including general construction and mechanical equipment was approximately $580,234.



Interior of a typical cell. Wall radiator is used for heating and is controlled from a central control panel supervised by a floor attendant. This photo used through the permission of the Department of Public Welfare, State of Indiana.



A typical corridor of a cell block showing a wall radiator underneath window at end of corridor. This photo supplied and used through the permission of the Department of Public Welfare, State of Indiana.



Typical zone controlled steam heating header as installed in the basement tunnel beneath cottages. Each cottage has six zoned sections with a controlling or pilot radiator located in each zone.

Gas Engine Cuts Air Conditioning Power Costs 71%

RECENTLY, the Heidelberg Hotel at Jackson, Mississippi, installed a 100-ton air conditioning unit to cool the lobby, barber shop, public rest rooms, 140 bedrooms and a roof garden that seats about 350 people.

According to Mr. Arthur Landstreet, the general manager, the hotel expected that the added consumption of electricity would possibly reduce the average rate in the hotel, and bring costs down to approximately 0.014c. per kw. hr.

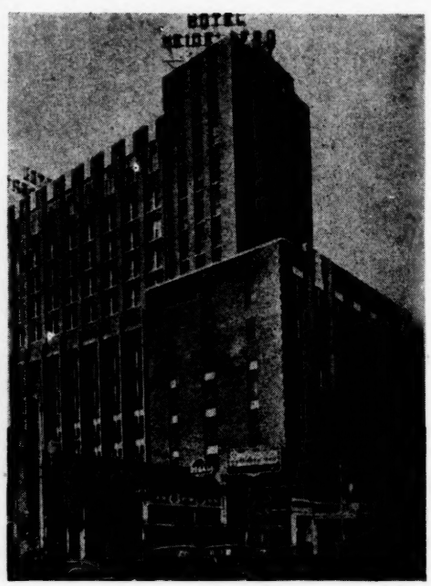
"To our consternation, when we turned the power on for the air conditioning unit, and received our bill at the end of the month, we found that our rate had been greatly increased," Mr. Landstreet says. "This increase was due to the fact that the demand charge developed by the 100-hp. generator spread over the entire electrical bill of the hotel."

To eliminate this demand charge, the hotel management began a study of prime movers which would handle the load economically. After several months of analysis and figures, they decided to install a six-cylinder Caterpillar diesel engine, converted to natural gas operation, and convertible back to diesel fuel use if necessary.

This engine, at 850 r.p.m. using diesel oil has a rated maximum capacity of 125 brake hp., and a continuous load capacity of 95 hp. Figuring that the average and sustained load on the air conditioning would not exceed 75 hp. or ¾ maximum capacity of the plant, it appeared that this engine would have ample power as a prime mover.

The total cost of the installation, including engine, foundation, belt and mufflers, was $4,159.70.

On June 11th, 1939, operation was switched from the power lines to the engine. A modulator control was included to control the operation of the engine. In operation the speed of the engine and the power developed varies with the load on the air conditioning system. It was found that the engine modulates its speed from around 550 revolutions to 900.



Shortly after the engine was installed, Jackson had one of the hottest spells on record with the thermometer standing around 104 for six or seven consecutive days. During this period, the engine was taxed to its capacity but did not appear to be overloaded. It ran at 850 to 900 revolutions.

As the weather moderated to more normal conditions the engine operated at 700 and 750 revolutions much of the time. In the early morning and night, when the atmospheric differential was not so great, the engine was running at 550 to 600 r.p.m.

The hotel claims that there is a distinct advantage in this modulation over motor driven power. With the electric motor drive, the compressor usually cuts out or the cold water is by-passed when the temperatures are reduced to the proper point in the conditioned areas. This means that the compressor and motor operate at rated speed, which in this case was 850 r.p.m. This continued maximum speed is said to create greater wear on the compressor, pistons and other moving parts.

In the case of the modulated engine, the engine, the compressor and all moving parts are slowed down to necessary cooling requirements of the job. This, over a period of years, reduces maintenance.

On the 23rd of September, the engine had operated 2,289 hours. It is estimated that about 36 hours might be eliminated for time that the unit was out of service. By this, it is meant time out to make necessary adjustments after the engine was first started—changing the oil, examining valves, and performing like operations and to prove efficiency guarantees.

During this 2,289 hours of operation, the engine had consumed 2,475,500 cu. ft. of gas, or an average of 1,098.7 cu. ft. per hr.

From the efficiency tables established by the engine builder, this would indicate that the average horsepower had been approximately 84.5 and that the average cubic feet of gas consumed per horsepower was 13 feet. The average cubic feet of gas consumption for thirty days at $0.20 a thousand was $58.20. The engine carried a maintenance guarantee of $0.00075 per hp., or $45.63 a month.

There were consumed 46 gal. of lubricating oil per month at $.603 per gal., or a total of $27.74.

By totalling gas consumption, the maintenance expectancy and the oil consumption, it was found that the unit had cost $231.57 per month to operate.

By transforming 60,840 horsepower hours to kilowatt hours and adding 10% for motor and power transfer efficiency, it was found that it would have taken 49,925 kw. hrs. to have handled this load by electricity. This amount of electricity at $.016 per kw. would have equalled $798.80, or 4.6 mills per kw. hr. By subtracting $231.57 (the engine's operating cost) it is found that this installation has saved $567.23 in operating costs each thirty days.

Collating Department of the Standard Register Co.

A SECTION OF "HEATING & VENTILATING"
INDUSTRIAL PLANTS PROMO
BY SCIENTIFIC CONTROL

THE STANDARD REGISTER CO.

now occupies two new factory buildings and a new office building, the latter year-round conditioned with a combination mechanical and well water system. Water from cooling coils sprayed on factory roof to reduce heat gains and losses.

By CLIFFORD STROCK

TO use the company's own phrase, the Standard Register Company, Dayton, Ohio, is "a business built on holes." Its products are a wide variety of forms for billing, accounting, tabulating, addressing and other business machines; these forms are assembled in duplicate, triplicate or quadruplicate with the carbon papers, all with holes punched along the margins to mesh with pins in the company's platen which is readily installed on the machines. The result is that the forms cannot slip, the spacing is accurate, and a great deal of time is saved by the machine operator. That the business is on a quantity production basis is illustrated by the capacity of the presses which print the forms and which require 1475 miles of paper every 24 hours.

Standard Register has applied continuous production principles to its own operations which have been completely mechanized to achieve efficient straight-line production. During the past several years the plant has been expanded from a total of 70,000 sq. ft. to over 150,000 sq. ft. of floor area. During one expansion a large one-story factory was added, and in a second enlargement a two-story plant and a new office building were added, the last being completely air conditioned.

The plot plan, Fig. 3 shows the relative location of the new and old buildings. The old factory was located in the upper left (Fig. 3) with the office building near the lower right. The new office building and the new factory building are at the right and the lower left, respectively. The boiler room which was modernized in connection with the new factory building is located as shown toward the top of Fig. 3.

The Factory

The two-story factory houses the press shop, unusual for the abundance of daylight provided through continuous horizontal runs of sash and monitors entirely enclosed by glass block. Monitor aisles, 60 ft. wide, provide maximum flexibility of operations and afford a clearance 17 ft. 10 in. below the welded roof trusses.

Since the major objective of frictionless form-feeding is to obtain absolute register in recording on multiple business forms, precision printing is the first requirement of the manufacturer. In expanding its facilities, Standard Register has made provision for inspection of plates with precision gages and microscopes which determine errors down to 0.001 in. in spacing or alignment.

The first floor of the new two-story plant section is of reinforced concrete construction, with columns of 20 ft. centers. It is equipped with a complete range of new motor-driven machine tools required for the manufacture and development of special press parts and in experimental work on new business machines. The second floor is of structural steel with a 60 ft. monitor aisle and accommodates the collating department.

When the presses were transferred to the new build-

ing, the management reorganized production facilities in the existing two-story structure, installing an entire new lighting setup and a system of mechanical and gravity conveyors which reduced handling costs. A unique overhead system by which copy, proofs and orders are conveyed between departments on an endless cable deposits material automatically at the various stations.

Boiler Plant

In connection with building the two new factory buildings the boiler capacity was more than doubled by intalling the two new steel boilers equipped with stokers. These boilers furnish steam to the factory heating system and for office heating through tunnels. The condensate is returned to a vacuum pump in the boiler house, these return lines also being laid in tunnels.

Factory Heating

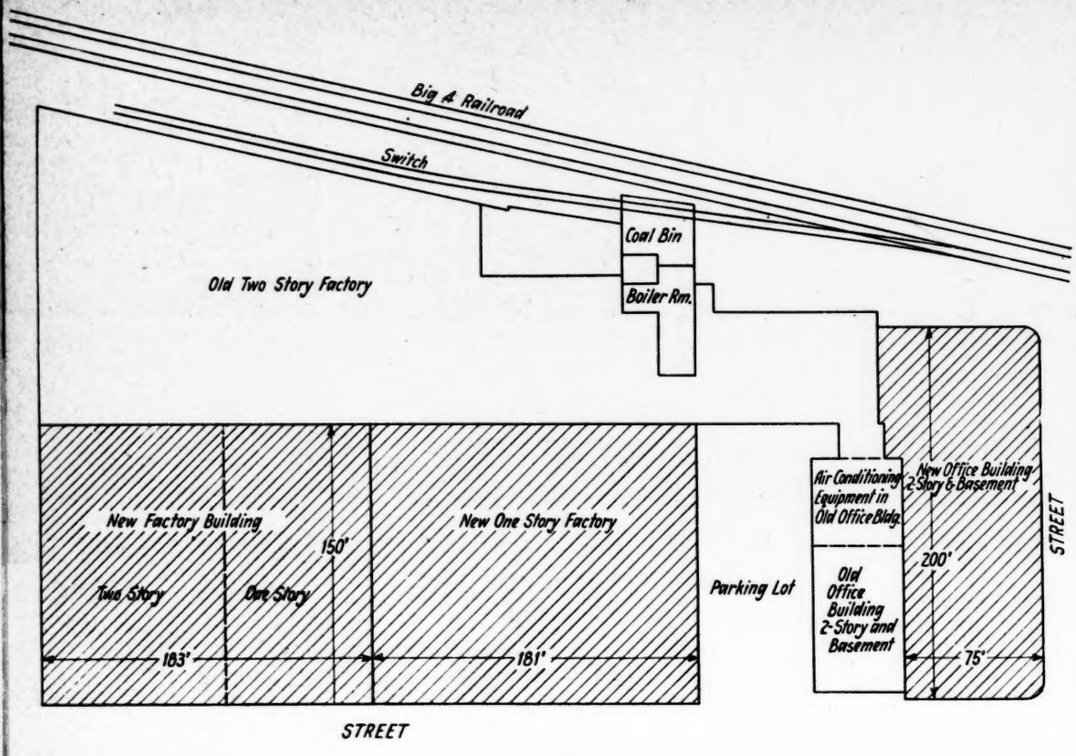
In Fig. 5 is shown a plan of the one-story factory building which is located between the new two-story factory and the old office building. The heating of this building is typical of that used throughout both of the new factory buildings. Steam enters as shown in the upper right through a 5-in. steam line from the boiler, circulates through the building and is then returned to the vacuum pump. Five propeller fan type unit heaters are located along the north, east, and south walls as indicated, with blower-type unit heaters of 400.000 B.t.u. capacity each located along the west wall. Details of the unit heater unit connections are shown in Fig. 9.

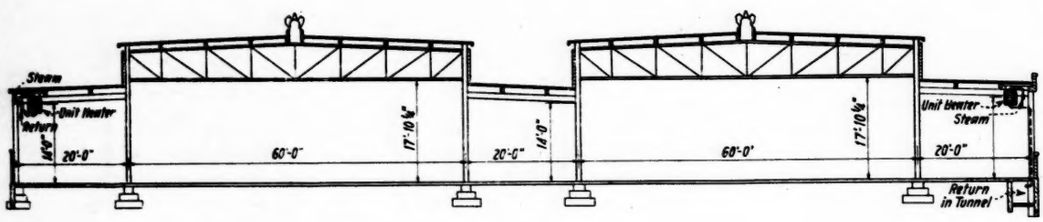
THIS INSTALLATION

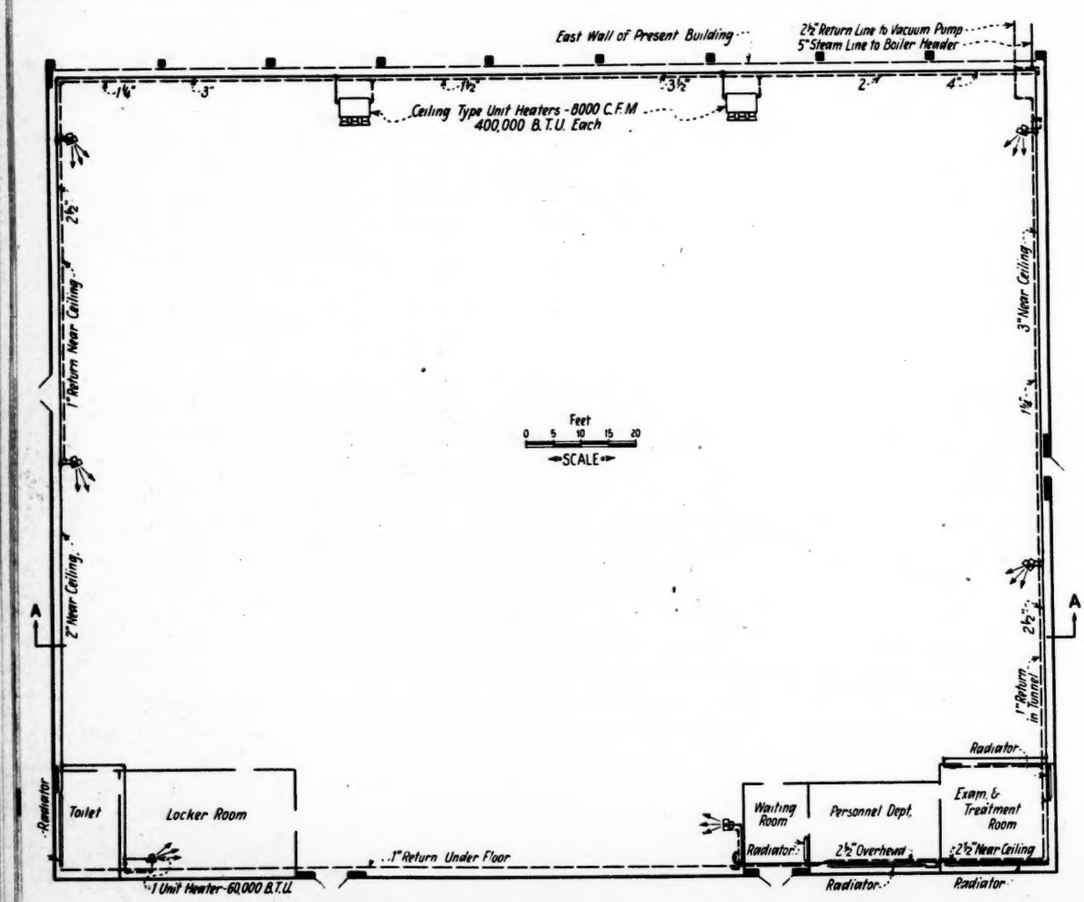
Owner—The Standard Register Co., Dayton, Ohio

Engineers and Builders—The Austin Co., Cleveland

Fig. 1. Aerial view of the Standard Register Company plant. In the foreground is the air conditioned office building while the new press building and allied printing departments are located in the new factory buildings in the left foreground. The old plant appears in the background while the old office is shown between the new office building and the new factory building.







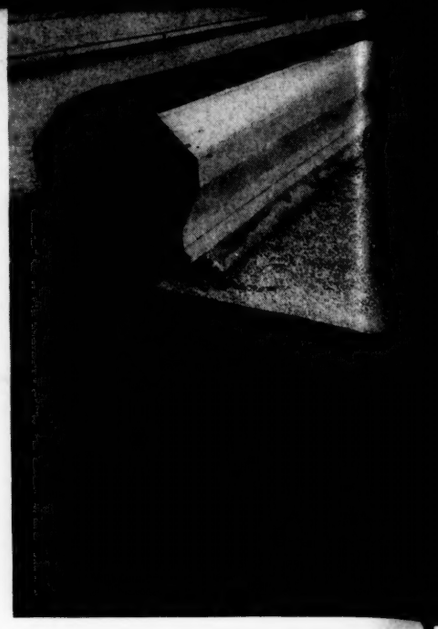


Fig. 2. Exterior view of the heat valves on the roof.

Fig. 3. Plot plan of the Standard Register Company plant showing location of new portions of the plant relative to the old.

Fig. 4. Section AA of the building shown in Fig. 5.

Fig. 5. Plan of the new one-story factory, with locations of ceiling and propeller-type unit heaters and radiators indicated, together with general arrangement of piping.

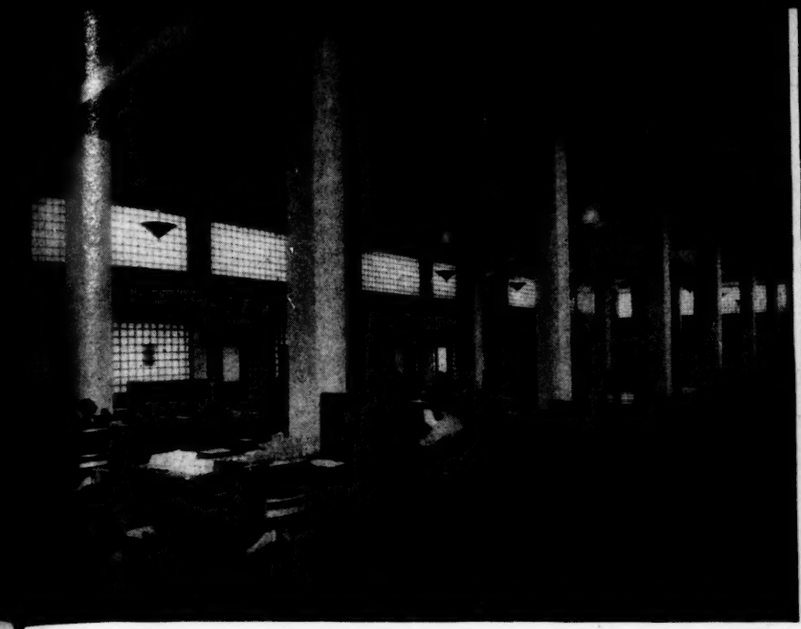


Fig. 6. A view of the second floor general offices which have 25 ft. ceilings. The air conditioning grilles can be seen above the columns in the foreground.

Fig. 7. The press room at Standard Register is considered to be one of the best lighted in the country. The presses require 1475 miles of paper every 24 hours.

covering the blower-type units and in Fig. 11, covering the propeller fan units.

Running lengthwise along the monitors are continuous heat valves or ventilators, the location of which is indicated in Fig. 4.

Heating of the two-story factory building is essentially the same. The one-story section of this building is heated by a propeller fan type unit heater and a large ceiling (blower) type unit heater. The first floor of the two-story section, housing the press shop, is heated by propeller type unit heaters while the second floor, where the forms are collated, is heated by one large blower type unit.

Office Building

The office building, designed for a maximum of working comfort, has approximately 50,000 sq. ft. of floor space and consists of two stories and a basement. Architecturally a sweeping streamlined effect is attained by use of round corners and horizontal lines, illustrating advanced ideas in functional design.

Entering through a lobby 35 ft. in length, visitors to the office find the symbol of frictionless feed of marginally-punched continuous business forms inlaid in colors on the terrazzo floor. Walls are surfaced with matched ribbon-grained walnut.

Assembly Hall

Included in the office facilities are a 96 x 48 ft. assembly hall in the basement, accommodating 500 people and providing a 20-ft. stage. In conjunction with this there is a motion picture projection room 15 x 17 ft. The basement also includes space for a future cafeteria and kitchen, 96 x 76 ft., an L-shaped display room 31 x 28 ft. and a fireproof record vault 32 x 17 ft. In addition to the large lobby and a general office, the first floor has a transcribing room, a teletype room, telephone and information bureau, purchasing offices, order department and other private offices.

On the second floor are a group of four special oak paneled executive offices, all with bronze period fixtures, cast stone mantles, and two complete private lavatories. The principal portion of the second floor is devoted to a lofty general office with 25-ft. ceiling height below a glass block enclosed monitor, surrounded on the outside by other private offices.

Office Air Conditioning

Year-round air conditioning is provided for the new office building. The equipment is located in the basement at one end of the old office building, as indicated on the plot plan. Cooling is by a combination of well water and refrigeration, 58F water being supplied from a 125-ft. well. The inside conditions maintained in the summer are 80F dry bulb and 50% relative humidity when it is 90F outside. Air enters the equipment room through louvers, as shown in the upper right corner of Fig. 10, and passes into a plenum chamber where it is mixed with recirculated air as desired and from which it passes through renewable. filters, through the fan, and thence to the water coils and refrigerant coils. The water discharged from the coils is pumped to the roof of the old office building and the old factory building where it is allowed to spray over the roof to a depth of 1½ to 2 in. to cut down the heat gains on the roof. In addition cork insulation is provided on the roof to cut down heat gains in the summer and heat losses in the winter.

From the equipment room the conditioned air is supplied to the auditorium and display room in the basement and to the various sections of the offices on the first and second floors. Grilles in the partitions connect the various spaces on the upper floors so that all of the

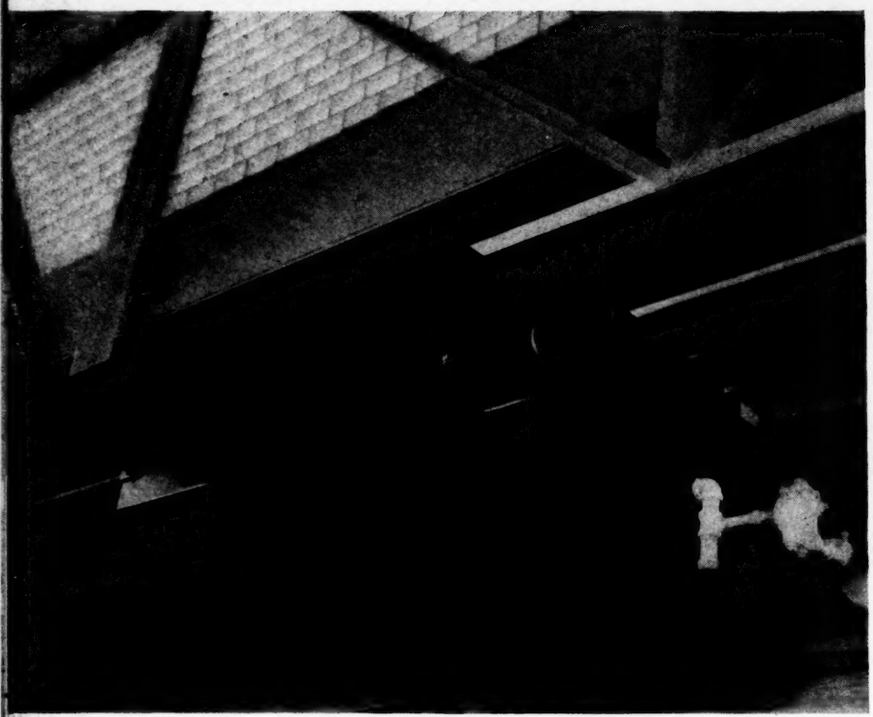


Fig. 8. A closeup of one of the ceiling type unit heaters which have individual thermostatically controlled dampers. These unit heaters are used to circulate the air in the summer.

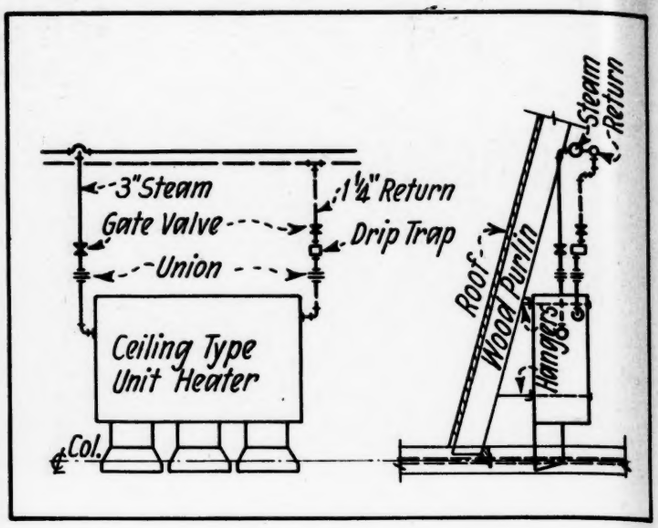


Fig. 9. Top view (left) and side view (right) of method of supporting ceiling type unit heaters.

returned air can be fed back to the conditioning equipment through one return duct on each floor.

Direct radiators are provided in the office building to take care of transmission losses in the winter and the air conditioning system furnishes heated air in sufficient quantities to take care of the infiltration. The radiators are thermostatically controlled with radiator control valves to take care of different areas, and with manual controls for offices with unusual exposures.

Fig. 10—(below) General arrangement of air conditioning equipment serving The Standard Register office. The shaded area indicates the ductwork and plenum chamber.

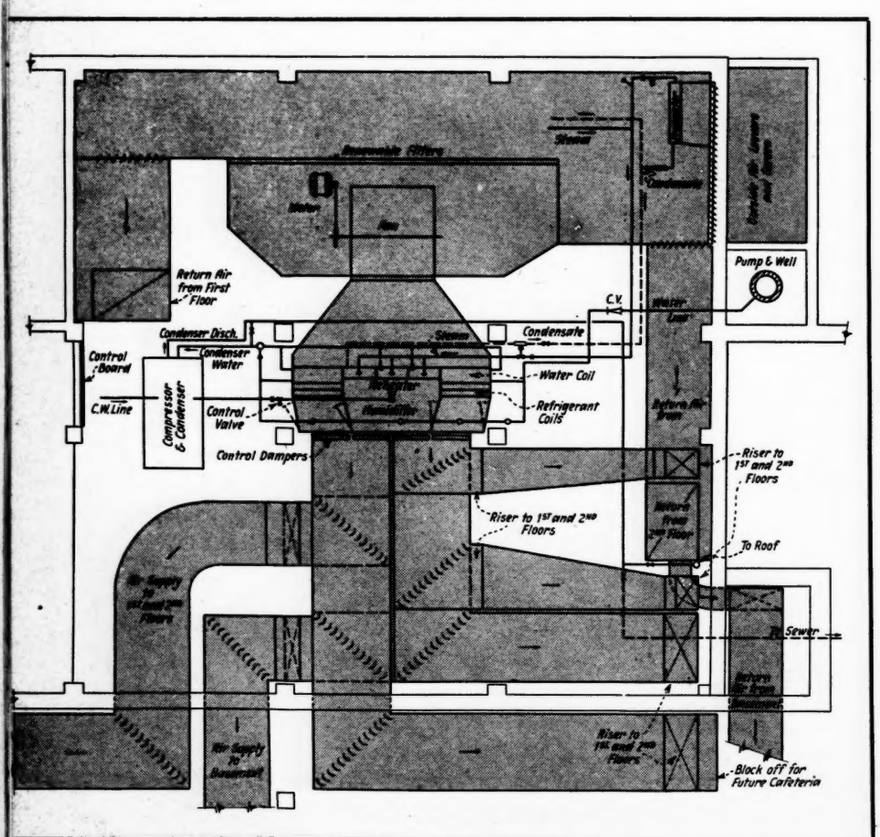
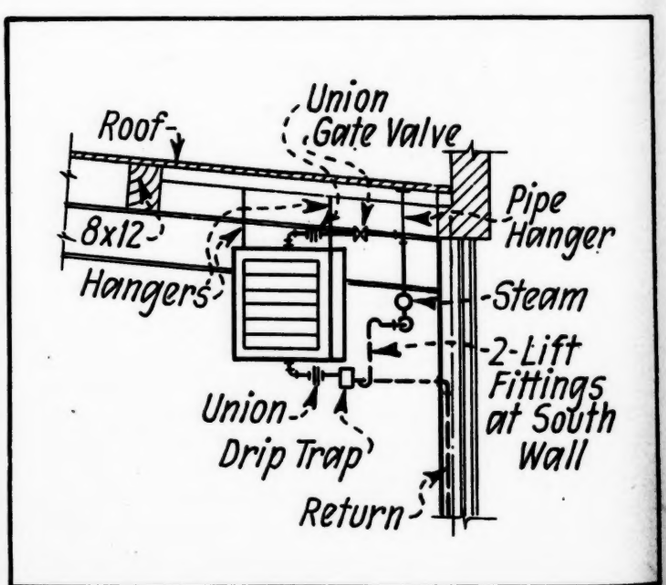


Fig. 11. Front view of typical propeller type unit heater and connections.



AMERICAN FORK & HOE CO.

modernizes its dipping departments by installing unit heater and exhaust ventilating systems. Results: drying has speeded up and working conditions greatly improved.

By R. C. TAFT†
as told to Francis A. Westbrook

PROFITS IN AIR

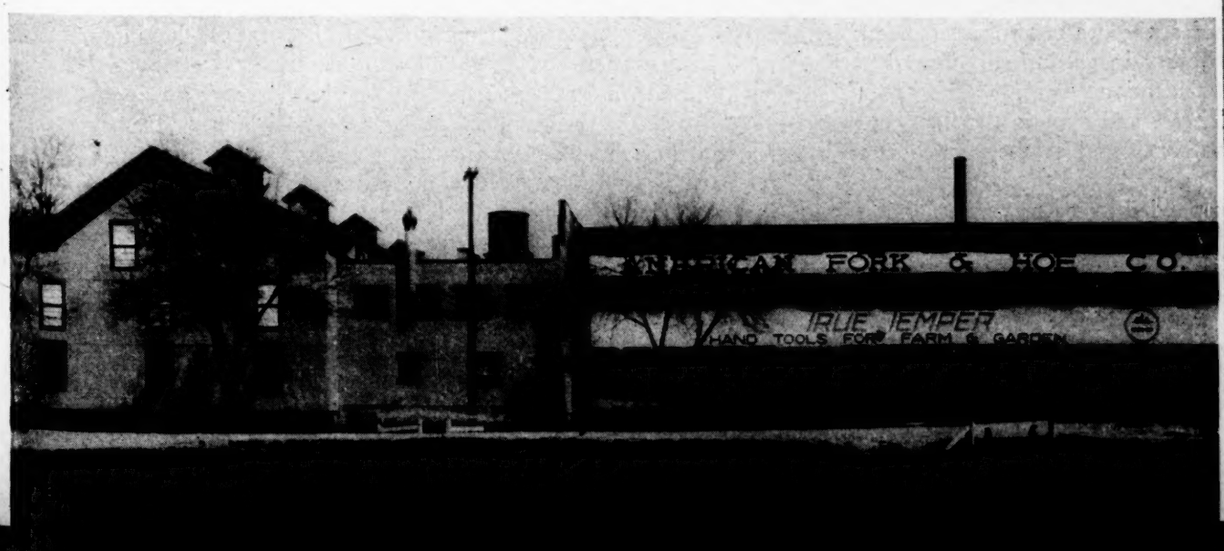
NO. 11 OF A SERIES SHOWING HOW INDUSTRIAL PLANTS PROMOTE PROCESSES AND PROFITS BY SCIENTIFIC CONTROL OF AIR CONDITIONS

THE American Fork & Hoe Company, at its Wallingford, Vermont, works, recently equipped a new room for giving a dip finish to the wooden handles of the hand agricultural tools produced here. The ventilation of this room has been carefully worked out for the removal of fumes without creating drafts. In addition, the room where the metal parts are dipped has also been similarly modernized. The results have been outstandingly satisfactory.

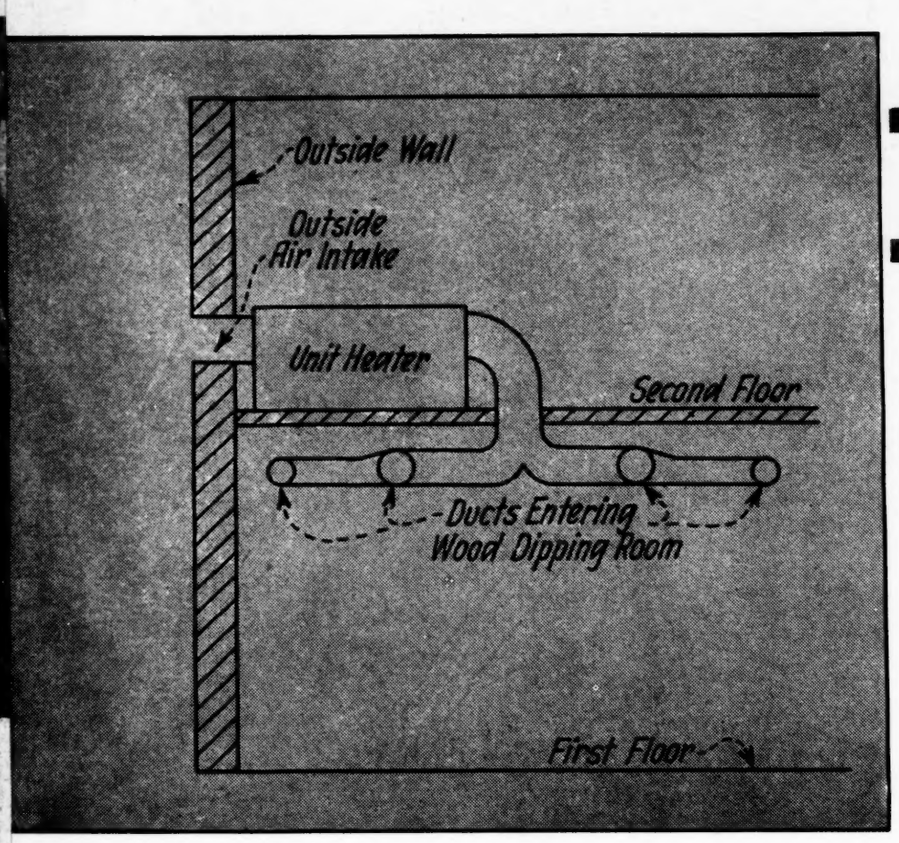
In the wooden-handle dipping department, located on the ground floor, the air is changed every two minutes. This is accomplished by means of a unit heater, located on the floor overhead and placed near an outside wall; this facilitates drawing in outside air without use of a long duct. It is equipped with a ½ hp. motor and two air filter cells. The outside air is heated in winter, and the blower runs all the time that dipping operations are in progress regardless of the season. The outgoing duct from the unit is divided into four ducts just below the floor, as shown in Fig. 1.

Outside air enters the dipping room through four openings which have been located as a result of careful tests to provide for a smooth, easy movement without

†Manager, Batchellor Works, American Fork & Hoe Co., Wallingford, Vt.



Plant of the American Fork & Hoe Company at Wallingford, Vermont.



< < PROFITS

Fig. 1. Elevational sketch showing heater and duct arrangement in the wood handle dipping department. (Not to scale.)

noticeable drafts. Two of the openings are on the north wall, one being about 2 ft. above the floor in the northwest corner, the other about 3 ft. above the floor near the northeast corner. Between these the third duct extends about 5 ft. into the room and 10 ft. above the floor. The fourth extends about 12 ft. into the room along the east wall and about 18 in. below the ceiling. This arrangement is shown diagrammatically in Fig. 3, which also shows the location of the dipping tanks, flush with the floor.

There are three exhaust openings as indicated in Fig. 3. One tank has its exhaust with the opening about 8 in. above the floor on the north side and the other tank has it on the south side. In addition, there is an exhaust opening in the southwest corner in the floor. The two exhausts at the tanks are served by one fan and that in the corner by another fan, so that even if one should be out of service the other would still be of great help. Besides, the use of two independent fans provides some flexibility in getting the desired suction of air from the two locations.

The fumes are heavy and sink to the floor and tend to flow toward the south end of the room due to the inflow of fresh air from the north end, while the handles are drying, suspended from the ceiling. The fumes from the tanks are pretty well taken care of by the exhaust intakes adjacent to them. The proper location for the fresh air intakes naturally is influenced by the equipment in the room and the drying products. The ceilings and walls have been made smooth to remove obstacles to the free flow of air. The two exhaust fans have a combined capacity equal to that of the unit providing fresh air.

In the metal dipping room on the second floor the arrangements are different, due to local conditions. This being the top floor of the building, the exhaust fan is located on the roof. The two units providing fresh air are suspended under the ceiling, under skylights with their intakes through openings in the latter.

The arrangement of the metal dipping room is shown in Fig. 2. There are several brick pillars through the center and dipping is done in tanks in both aisles. The dipped parts are suspended from monorail trollys under the ceiling which circle the room. The two unit heaters are on the west side of the room and have their vanes adjusted to direct the flow toward the east side on which the exhaust openings are located. These are of a capacity to change the air every two minutes.

There are four exhaust lines, as shown, each having an opening at the floor and another about 4 ft. above the floor, as shown in Fig. 3. The roof blower serving these has a rating of 5822 c.f.m. As will be seen from the diagram, the exhaust line is increased in size at each intake. There are no exhausts at the dipping tanks as these are moved from one point to another, depending on the products in process at a given time.

The ventilation of this metal dipping department is a modernization job. It never had proper ventilation before and as a result the working conditions were none too good and the hazards unnecessarily great.

IN AIR > >

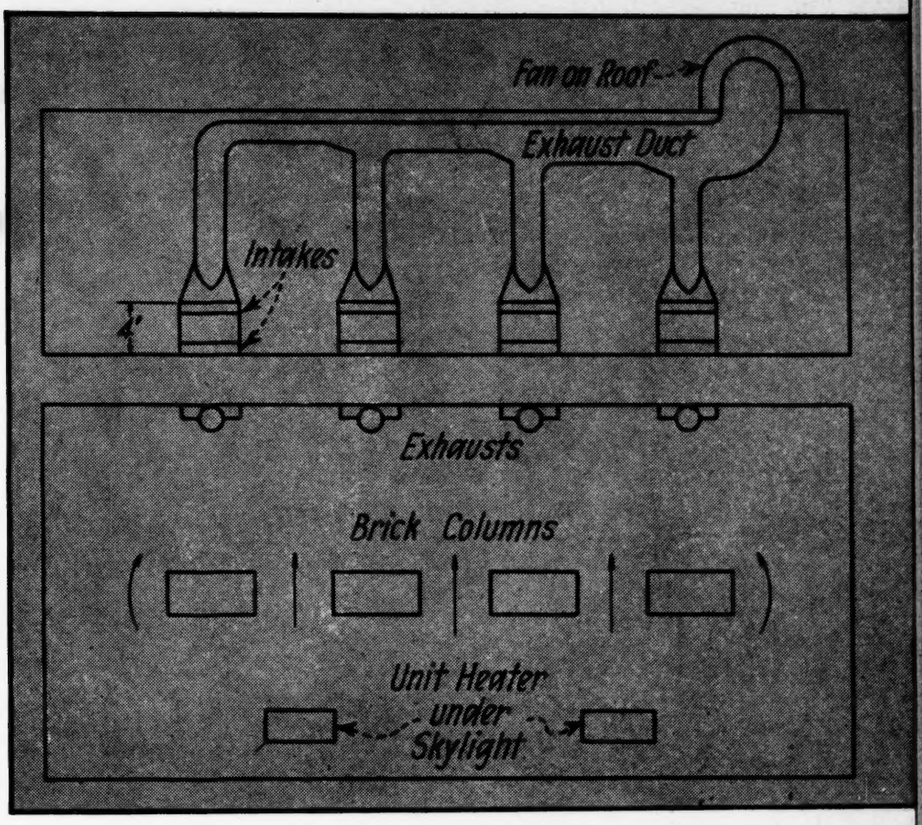


Fig. 2. Plan of metal dipping room and (above) elevation along exhaust outlets. (Not to scale.)

The introduction of a modern system has had several good results. Drying has been speeded up, working conditions greatly improved and the insurance people satisfied. The installation is too recent for any figures to be available on increased production, but the manager feels that he has wiped out a weak spot in the plant which needed it badly.

As regards the wooden-handle dipping department, it is new within the year and the ventilating system was installed with it. This was absolutely essential as the dipping compounds are of such a character that it would be impossible to carry on without it. That is, nobody could work in the room, as the hazards would be too great, nor would the dipped handles dry quickly enough. As it is the working conditions are good and the process is carried with due expedition and safety. The metal dipping materials were less in their ill effects so that this department could function with antiquated ventilation, but when the advantages of the modern system in the wooden handle dipping department became apparent the object lesson impelled the management to improve the other department.

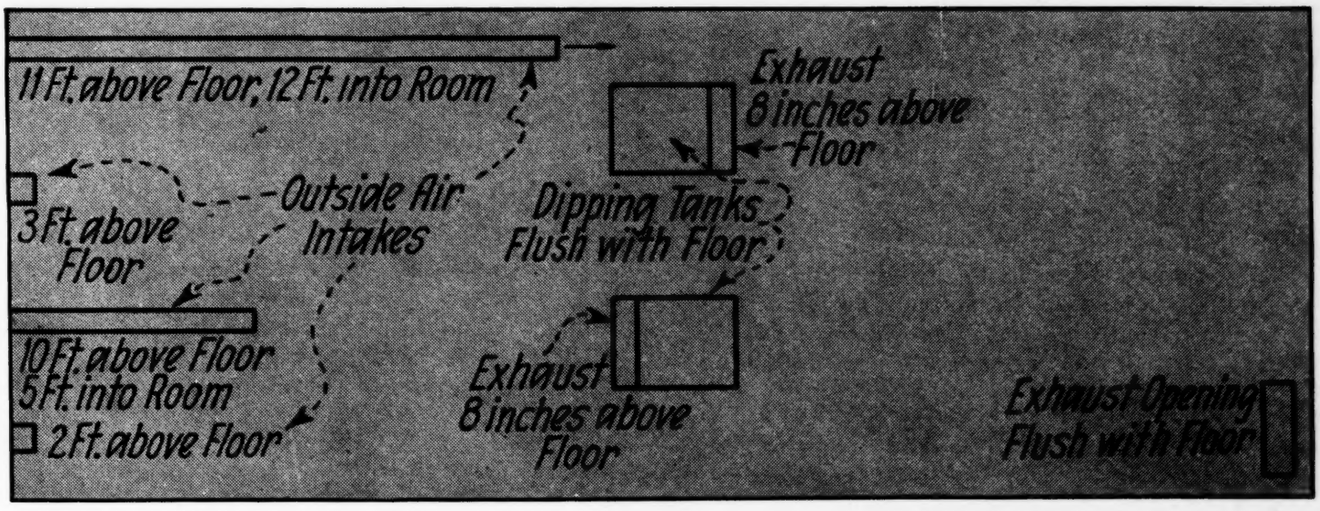

11 Ft. above Floor, 12 Ft. into Room
Exhaust 8 inches above Floor
Outside Air Intakes
3 Ft. above Floor
Dipping Tanks Flush with Floor
10 Ft. above Floor
5 Ft. into Room
2 Ft. above Floor
Exhaust 8 inches above Floor
Exhaust Opening Flush with Floor

Fig. 3. Plan of arrangement for ventilating the wood handle dipping room. (Not to scale.)

DUST CONTROL

in industry is dealt with in this series of three articles which outlines a program for a complete system of dust control.

By F. F. KRAVATH†

WITH the trend in legislation being to compensate victims of occupational disease, and with the feeling gaining ground that it is not true that dusts other than of siliceous composition are harmless, and hence, excluded from the occupational disease classification, it becomes increasingly important for industry to look around and decide for itself what measures are to be taken to completely protect prospective employees, present employees, and the company itself, its stockholders and their investment.

The question may be asked, "Protect whom from what?" The prospective or present employee should be protected from coming into contact with anything or anybody that will give him any disease, sickness, or permanent or chronic incapacity. This might include anything from tuberculosis, silicosis, dermatitis, or monoxide poisoning down to the inhalation of a *harmless* dust which nevertheless causes chronic inflammation of the lungs and susceptibility to numerous colds, and perhaps pneumonia. The prospective or present employee with a latent disease, whether it be of a pneumoconiotic or skin pattern, should likewise be protected from an environment which would inflame it and bring ill health. Ill health among employees cannot help but prove costly to the company.

Aside from the health angle, what are the effects of a dusty atmosphere, as far as the company is concerned? In a number of cases, the dust is extremely valuable, and uncontrolled, represents a distinct loss, although in most such cases it will be found that some measure for the capture of the material has been taken. In cases where the material is not of great value in small quantities—by far the worst effects of uncontrolled dust are (a) definitely lowered production, (b) inferior workmanship, (c) drastically lowered life of machinery, much of it extremely costly. The author writes, here, from experience. In one production room, where the author installed an adequate exhaust system with extremely carefully designed hoods, production increased approximately 20%, quality was bettered to the point that make-overs were eliminated, and maintenance dropped some 35%. It is not at all hard to see how the foregoing affects the stockholders and their investment.

A complete system of dust control calls for the complete co-operation of the company management, and engineering and medical staffs. Without the full co-operation of all three, the system is not complete and may be even haphazard. The author will set up a model system and show how the three groups must co-operate for maximum effectiveness.

New Employees

It is essential that complete information should be gotten relative to the occupational history of all prospective employees, and the logical agency to procure it is the personnel department of the company. An occupational history of any value should include the following data: (1) Name, address, age, and questions usu-

†Assistant Plant Engineer, Abrasive Company, Philadelphia.

ally asked; (2) name of each place worked since employment began (regardless of state, territory, or country) and dates of beginning and termination of employment at each; (3) exact nature of work performed, and description of environment at each place of employment, stressing presence or absence of dusts, fumes, gases, etc.; (4) previous physical and x-ray examinations and approximate date of each; (5) whether applicant was ever told he had any incapacity or was unfit for service at any particular plant.

To these questions may be added any that the medical staff may desire such as (6) previous lung trouble, pneumonia, susceptibility to colds, presence of tuberculars in immediate family, and similar queries.

The purpose of such a questioning is many fold. An alert and sympathetic questioner can gain enough information from some of the answers, when coupled with the applicant's appearance, to definitely reject the applicant as one unsuited to employment (at the particular company from the standpoint of the risk involved to the company, and the health of the applicant). This saves the expense of physical and x-ray examinations which would disclose the same thing, as well as the administrative, clerical, training, and other normal expenses involved in employing and discharging an employee within a week. Sometimes, prospective employees will try a subterfuge in an attempt to mislead the examiner and hide some lung ailment or partial disability. A simple, yet effective method of disclosing advanced cases of lung disability is to have the applicant mount and dismount an ordinary chair some ten consecutive times. People with other than good lungs will generally experience pronounced shortness of

PART I—THE DUST PROBLEM, EMPLOYEE EXAMINATIONS, DUST SURVEYS.

Fig. 1 (left) — Convenient Form for Keeping Record of Employee Lung Examinations. Fig. 2 (right) — Form for Recording Results of Monthly Dust Count Survey.

EVIDENCE AND EXTENT OF LUNG PATHOLOGY AMONG EMPLOYES

NAME	EMPLOYE NO.	N.L.P.	PNEUMOCONIOSIS STAGE 1	2	3	SILICOSIS STAGE 1	2	3	ACTIVE TUBER.	REMARKS
J. Doe	346	9/39								OK
Chas. Coe	992				9/39					OK
Wm. Roe	193							9/39		Emphysema, severely disabled, partly disabled
R. Jones	662							10/39	10/39	Totally disabled
S. Smith	882	11/39								OK

MONTHLY DUST COUNT IN MILLIONS OF PARTICLES PER CUBIC FOOT

DEPARTMENT	LOCATION	ITEM	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
	1	Count	35	30	21	19	15	19	17	19	20	19	19	80
Machine	2	Stat'g	15M	15M	15M	20M	20M	15M	15M	10M	5M	10M	10M	10M
Shop	3	Time F.	65	67	67	66	72	80	85	87	95	65	65	67
	4	T.H.	50	55	60	50	60	70	80	82	75	50	42	46
	1	C												
Foundry	2	S												
	3	T												
	4	T.H.												
	1	C												
Finishing	2	S												
Room	3	T												
	4	T.H.												
	1	C												
Crushing	2	S												
Dept.	3	T												
	4	T.H.												

INSTRUMENT Dr L TAKEN BY _____

breath. Of more value than the foregoing, the occupational history helps in determining what dusts, if any, the applicant was exposed to so that this information may be available to the medical staff. Another value of this history is to enable the company to escape unfair allocation of responsibility, as regards compensation, should the employee become disabled.

Many plants give their prospective employees complete physical examinations. Since a physical examination, in itself, is insufficient to definitely disclose every lung ailment, and the degree of pathology involved, enlightened companies are supplementing this with the x-ray examination of the chest. It is essential that the roentgenologist be supplied with accurate data relative to the extent, quality and duration of the lung inhalation of atmospheric impurities by the applicant. The value of this information cannot be underestimated. Five roentgenologists given five different occupational histories of the same subject are very apt to render five different analyses. Given no information whatsoever, it is almost a certainty that more than one interpretation will result; hence, it is obvious just what care must be taken in securing accurate information.

Assuming the applicant has passed his examinations and is acceptable for employment, that does not end the company's interest in his lung pathology. From the opinions, as rendered by the medical staff, it is decided at what future date the employee is to be called up for a re-examination, which will now become periodic, the period depending upon the employee's last examination reports. For this purpose, the simplest and most effective way of insuring that no one is forgotten is to keep a small tickler. The tickler, consisting of nothing more than 24 cards labeled with the month of the year over a period of two years, can be kept in a small box under lock and key. On the card representing the proper month for re-examination is put the employee's name or number. Automatically, then, each month a group of men will be up for re-examination. Records should be kept of both the physical and x-ray examinations for future reference. Illustrated in Fig. 1 is a chart for recording the lung condition of employees, as disclosed by the x-ray examination. It is ideal for the records of the engineer in charge of dust control, since with a minimum of effort it is possible to check the entire personnel and see the comparative extent of lung pathology.

Interpreting the chart, after the employee's name and employment number are the various columns showing the extent of his lung pathology from the ideal N.L.P. (no lung pathology), successively through the first, second and third stages of a pneumoconiosis, or the first, second, and third stages of silicosis, to finally an active tuberculosis. The last column, headed by *Remarks*, contains a quick summary of the employee's condition being either *OK*, *Partially Disabled*, *Totally Disabled*, or some other pertinent classification. The date of each x-ray examination is placed in the column corresponding to the correct classification for each employee. Thus, referring to the chart again, John Doe, employment number 346, was examined in September, 1939. His x-ray print revealed a normal lung and he is *OK* to continue his employment. By contrast, Richard Jones, employment number 682, was examined in October, 1939, and was found to be totally disabled, suffering from a third stage silicosis which had become complicated with tuberculosis. This man, obviously, must be refused any employment for two reasons—the first, because almost any work will be beyond his capacity and treatment at some sanatorium might prolong his life; the second, because this man is now a dangerous carrier of tuberculosis germs and very apt to transmit his disease to any fellow workers periodically coming into close contact with him.

Present Employees

It is extremely helpful, for many reasons, to carry on an almost identical program for the present employees, especially the x-ray examination, the up-to-date occupational history for correct diagnosis of prints, and the classification of results. A chart such as illustrated is helpful in showing the effects of continued exposure to the workroom atmosphere of any plant or portion of a plant, indicating the efficacy of the dust control equipment therein installed. It also is of value in indicating the proper time to remove an employee to another position where the dust hazards may be considerably lower, or where the physical work entailed is much less exacting.

It is not the purpose of this article to delve into matters that are the problem of the management, such as just what is to be done with the workers displaced from industry by becoming victims of some occupational disease. Governmental, social, and industrial agencies have started wrestling with this problem and will no doubt reach a satisfactory answer. It is very much the purpose of this article to point out what measures may be taken to avoid the contraction of an occupational disease, to minimize its spread in the plant, check its growth in the individual, and safeguard both the plant employees, and the company itself.

Plant Survey

A complete system of dust control must include both a quantitative and qualitative analysis of whatever dusts are present in the various workrooms of a plant. Since we are primarily concerned with the condition of the air at the breathing level, that should be the place to take dust counts of any significance. Samples for a qualitative or chemical analysis may be gotten from rafters (a not altogether reliable indication) or from the dust filter. Dusts, in general, may be collected by such instruments as the B and L dust counter, the Greenburg-Smith impinger, the Owens jet dust counter, and the konimeter. Lead fumes cannot be caught in this manner and it is necessary to use an electric precipitator. Besides dusts, the impinger is capable of catching such gases as hydrochloric acid (soluble in water) and such aqueous mists as chromic acid. Dusts that may be affected by water, such as soap, leather, or flour are not efficiently caught by the impinger, and one of the other instruments should be used. Chlorinated hydrocarbons are caught chemically, while some pure gases (uncontaminated with other constituents) are condensed by circulating through a dry-ice mixture, and then measured or estimated afterwards. This article does not attempt to discuss the technique of dust sampling nor the theory of its identification, but it does stress the importance of routine checks. Each department should be checked periodically to insure continued efficacy of the exhaust apparatus or other dust control equipment. It is obviously unnecessary to take a dust sample near a broken hood, a leaking elevator, or some other device temporarily out of order. The fact that the dust is visible is assurance enough that the concentration is too high. However, a clean appearing room does not necessarily spell a hygienically safe atmosphere since border-line concentrations of extremely fine dusts may be invisible, yet dangerous, while many toxic gases and fumes are colorless. Referring to Fig. 2, here is shown a sample chart for recording dust concentrations in the various parts of a plant over a period of years. This can also be plotted as a graph, with the months of the year as abscissae and the dust concentration in millions as ordinates. In Fig. 2 is included a space for the name of the engineer in charge of dust control or his designate, and the type of instrument. Since it has been shown that there is little correlation between the results obtained with the various dust counters on the market, it is necessary to qualify the result by mentioning the instrument it was obtained on. Without necessarily stating that any single type is less accurate than any other, it may be correctly said that some instruments are more sensitive to larger dust sizes, some to smaller, some to higher dust concentrations, and some to lower, each being more revealing to some particular concentration and sizing of dusts, not to mention the type of dust. Referring to the column headed *Location,* it is generally preferable to have more than one area within any department checked in order to get a more representative result. It is wise to designate certain areas in each department as dust counting stations, identifying each by a number or letter, and periodically returning to each for the dust count. Factors to be considered in the selection of a dust counting station are severity of dust concentration, types of dusts or fumes liberated, grouping of operators, and arrangement of machinery in various locations. At least three samples should be taken at each location and only the representative figure, not necessarily the average, should be recorded.

It is of great value to record the average sizing of the material collected. The temperature and humidity are of value in obtaining an intelligent comparison with previous counts. While the amount and sizing of the dust given off from any process may be unaffected by atmospheric conditions, it is self-evident that the proportion of material which will tend to remain suspended in the air and affect the total concentration is very much dependent on the density of the air, affected again by the temperature and humidity. Hot dry days are generally atmospherically clean days, while colder or damper weather is more conducive to the suspension of much fine material. A chart such as shown in Fig. 2 can give a comparison of conditions in the entire plant, over a period of a year, on one sheet.

It is a wise procedure, when taking dust counts throughout a plant, to spend fifteen minutes and obtain some dust counts at least one-quarter to one-half a mile from the plant and in a direction facing the prevailing wind. This is of value in presenting comparative conditions inside the plant and outside, at such a point that it could not possibly be affected by any dust that might be discharged into the atmosphere by the plant itself. As explained previously, while dust counts are of little value when compared with counts as obtained on dissimilar instruments, they do give a rough general check on standards of permissible dustiness as set by state authorities or recommended by medical men, and are of great value in showing comparative conditions at different locations or at different times as measured by the same instrument.

When The Contractor Signs An Order

By CHARLES R. ROSENBERG, Jr.†

THE heating and ventilating contractor laid a printed order form on his lawyer's desk.

"That's the copy the salesman left with me. I signed the one he took with him," he explained, "but I signed it on the definite understanding that I could cancel within a week. Now they won't accept my cancellation."

"Just what did the salesman say?" the lawyer asked.

"First of all, he said the order wasn't binding at all. It was simply a salesman's memorandum form that he—"

"You didn't know him or his house, did you?" interrupted the lawyer.

"That's right, I didn't; but how did you guess it?"

"That's not a guess. No legitimate, established house would use such tactics. The fact that the salesman said that the paper you signed was not binding does not help you in the least. That was simply his opinion, and you are supposed to know the legal effect of a paper you sign just as well as the salesman does. If it turns out that he was wrong in thinking that the paper was not binding, you are legally liable just the same."

The contractor frowned.

"Well, even so, he agreed that he would not turn it in for a week and that I could cancel within that week by writing to him in care of his firm. I mailed a cancellation the day after I signed the order, but the firm immediately answered that they had entered my order and would not accept a cancellation."

The lawyer looked at the order form closely.

"There's nothing here about cancellation. Besides, it would be pretty hard for you to prove that his firm authorized him to accept orders subject to one week's cancellation."

"Isn't it up to his firm to prove that the salesman did not have the right to make a cancellation deal?"

"No, the law is the other way. If you sign an order or make any kind of deal with a business house through a salesman or other representative and any question arises about oral promises, the burden is on you to prove that the salesman or representative actually had the authority to make the oral terms he offered you. Unless you could prove by legal evidence that the salesman was authorized to give you the privilege of cancellation within one week, you could not enforce that condition against his firm."

"How am I supposed to know what his authority is?" demanded the contractor.

"I can't answer that," admitted the lawyer, "but the law is that if you deal with a salesman, agent, or representative acting for someone else, it is up to you to find out and if necessary prove that he had the authority to make the deal for the someone else."

"You don't seem to think I have much chance in this thing," said the contractor disappointedly.

"Truthfully, I don't think you have any chance at all to beat this signed order," replied the lawyer.

"If I do have to go through with it, then, and accept the goods and pay for them, can I insist upon the extras that I am supposed to get? The salesman promised me fifty dollars worth of additional items when I paid for the goods I ordered."

"Nothing like that is mentioned in the order form," the lawyer pointed out. "In fact, there's a clause here that would make it legally impossible for you to enforce a promise of extras."

The lawyer pointed to a sentence in fine print. It read: "This contract constitutes the entire agreement and understanding between the parties."

"How is a man to protect himself against this sort of thing?" demanded the contractor.

"One way is by dealing with only legitimate houses with an established reputation in the trade. They are looking for satisfied customers and not legal technicalities. It's true that a contract may be set aside where a person has been induced to sign it by fraud, but ordinarily that's a rather difficult thing to do. For the most part, the courts have done that in cases where people were induced to sign the contract by some fraudulent device or representation which led them to believe that they were signing a different paper.

"You were high pressured by a salesman from an unreliable outfit; but you are able to read and write the English language, and you had an opportunity to read this order in full before you signed it. The fact that you signed it under a misapprehension as to its legal effect, or as to the value of the salesman's promises about cancellation and extra items, does not let you out."

Which suggests three practical rules for contractors in signing orders for equipment, supplies or other items:

1. Never sign an order or contract form for a house not known to be reliable.
2. When in doubt about the effect of an order or contract, submit it to a lawyer before signing, not after.
3. When signing an order for an honest and legitimate house, read it carefully to avoid misunderstanding and to make sure just what the house is undertaking to do. It's unfair to an honest concern to expect them to do more than the contract calls for just because you misunderstood what the agreement meant.

Submit contracts to your lawyer before—not after—signing!

†Attorney-at-Law, Media, Pa.

Estimating Heat Flow Through Sunlit Walls

PART I—WALLS OF ONE MATERIAL

By C. O. MACKEY† and L. T. WRIGHT, JR.‡

The problem of finding a rational method of determining the cooling load as affected by solar radiation on building surfaces is a very important one. Tables have been available for some time giving the instantaneous cooling load due to the transmission of solar radiation by window glass. Heretofore there has been no published method whereby the effect upon the cooling load of sunlit walls and roofs could be obtained. The authors of this article have developed such a method. It is being published in HEATING & VENTILATING in three parts.

In the present installment the authors outline a method of determining the maximum rate at which this heat flows to the indoor air through a wall of a single material. They also show how to determine the time of day at which the maximum heat flow occurs. In succeeding installments they will present methods of calculation for use with composite walls and will show how the method may be applied to typical constructions.

AN accurate estimate of the cooling load is essential to a selection of air conditioning equipment that will maintain the desired state of the air within an enclosure. It is difficult to estimate the cooling load by entirely rational methods, for it is not easy to calculate how much solar energy is absorbed by outside surfaces of the building, and further, to tell what part of this heat actually reaches the indoor air. Also, due to storage of heat in the building materials, considerable time may elapse between the time of maximum rate of heat reception at the outside surface and the time of maximum rate of heat transfer to the indoor air. Furthermore, all the components of the cooling load do not reach their peaks at the same time, and an estimate of the load must commonly be made for several different times of day.

The sensible heat gain caused by the absorption of solar energy incident upon the various building surfaces is often a large part of the total cooling load. The intensity of this solar energy in a plane perpendicular to the sun's rays, I_o, may be measured by a pyrheliometer. When this intensity is known, the intensity of the solar energy on horizontal surfaces and vertical surfaces of various orientations may be calculated for any latitude, time of the day, and day of the year. Tables in various text and reference books give the solar energy incident upon such surfaces for one declination of the sun, several latitudes, and times of day, and for an assumed variation of I_o with time of day. In addition to the solar effect, another important component of the cooling load is the sensible heat gain due to temperature difference between outdoor air and indoor air.

The gain of solar heat through *unshaded glass* may be estimated from readily obtained tables. This gain of heat is usually considered to be an instantaneous load on the cooling equipment. This component of the cooling load will not be discussed further here, for rational methods of estimate are complete. However, note that radiant energy transmitted by glass may fall on floors (or other materials) of high heat capacity. In this event, heat is absorbed by the floors and transferred by convection to the room air at a slower rate and with an appreciable time lag.

At the present time, there is no rational method available to the engineer for a reasonably accurate and quick estimate of the effect upon cooling load of solar radiation and air temperature differences and the development of such a method is the subject of this article.

Since most walls and roofs transmit directly no radiant energy, part of the incident solar energy is absorbed and part reflected. When the radiant energy is emitted by a high-temperature source, such as the sun, the absorptivity of a surface depends primarily upon its color, and approximate values are given in Table 1.

It is easy to calculate the transfer of heat to indoor air, due to solar effect and temperature difference, *if a steady flow of heat is assumed to exist.* (Steady flow means that the temperature at a given point in the material does not change with time and, consequently, that there is no storage of heat.) For example, the steady flow of heat through a 12-in. concrete west wall ($k = 1$ B.t.u. per hr. sq. ft. deg. F; absorptivity = 0.5) is desired at 4 P.M., if the outdoor air temperature at this time is 95F, the indoor air temperature 80F, and the incident solar energy is 211 B.t.u. per hr. sq. ft. (In this example the outdoor air film coefficient of heat transfer will be taken as 6, and the indoor air film coefficient of heat transfer as 1.65 B.t.u. per hr. sq. ft. deg. F.) For *steady heat flow,* the rate of heat transfer is given by the following equation:

$$\frac{q}{A} = \frac{1.65\,(bI + 6\Delta t)}{7.65 + \frac{9.9L}{k}} \qquad \text{.....(1)}$$

when $\frac{q}{A}$ = the rate of steady heat flow, in B.t.u. per hr. sq. ft.,

b = the absorptivity of the surface,

Δt = the temperature difference between outdoor and indoor air, degrees F,

L = the thickness of the wall or roof, in ft.,

k = the thermal conductivity of the building material, in B.t.u. per hr. ft. deg. F.

†Professor of Heat-Power Engineering, Cornell University.
‡Graduate Student in Mechanical Engineering, Cornell University.

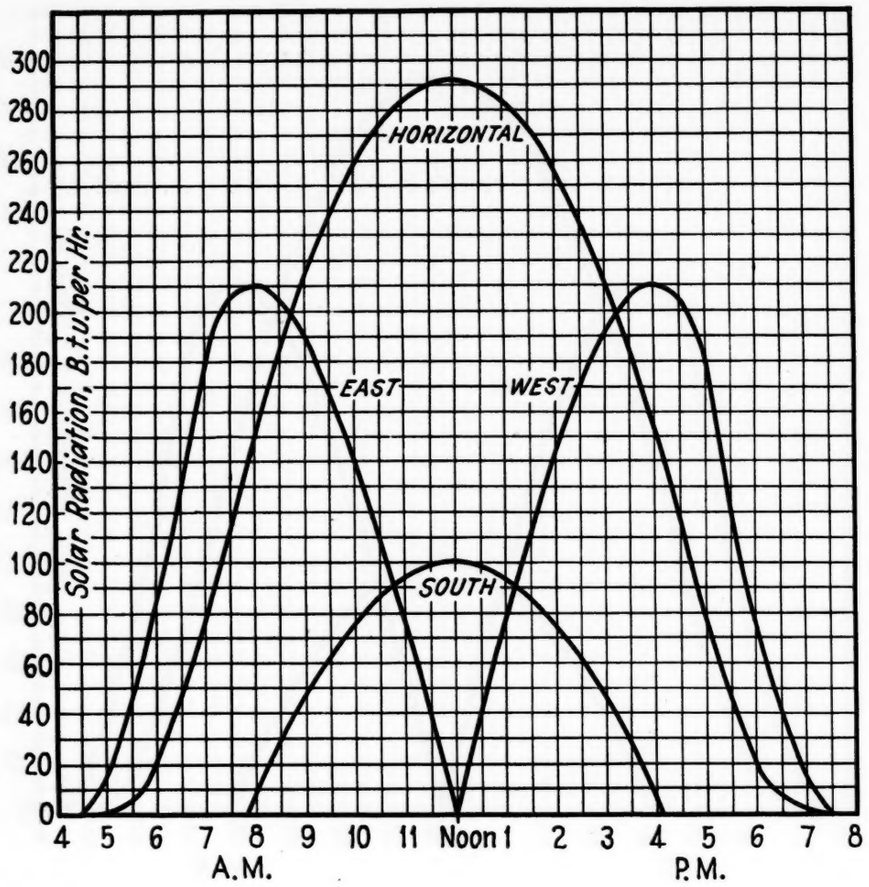


Fig. 1a. Solar radiation incident on various surfaces of a building.

For the wall of the example,

$$\frac{q}{A} = \frac{1.65\,[0.5(211) + 6(15)]}{7.65 + \dfrac{9.9(1)}{1}} = 18.4 \text{ B.t.u. per hr. sq. ft.} \qquad \text{.....(1a)}$$

The example shows that, even with *steady heat flow*, all of the heat absorbed at the outdoor surface does not reach the indoor air, for the temperature of the outside surface exceeds that of the outdoor air. It is interesting to note that, without the sun effect, the steady flow transfer of heat through this wall would be 8.46 B.t.u. per hr. sq. ft.

In all the work that follows, the solar energy incident upon the building surfaces corresponds to that given in Fig. 1a for a city with a north latitude of 40° and for the twenty-first of July.

The variation of outdoor air temperature with time of day is important in estimating the cooling load. If the dry-bulb temperatures that will not be exceeded more than, say, six times per year are plotted against time of day, the temperature will be found to go smoothly downward through the night, reach a minimum at about 5 A.M., rise rapidly, at first, and then more slowly to a maximum at about 3 P.M. The daily variation of outdoor air temperature assumed in all later work is shown in Fig. 1b, a constant indoor air temperature of 80F is also assumed. The authors realize that all these assumptions are quite arbitrary, but they do not limit the results as much as one might first believe.

Actually, steady flow of heat does not exist at all times due to the capacity of the building materials for the storage of heat and to the change of air temperature and incident solar radiation with time of day. For the 12-in. concrete west wall of the example, the maximum rate of *steady* flow of heat may occur at about 4 P.M. but it will be several hours later before there is a maximum rate of heat transfer to the indoor air from this wall; also, at this later time, the rate of heat transfer will be much slower than that calculated for steady flow conditions at 4 P.M. It is the purpose of the remainder of this article to show how the time lag and the diminution in the steady flow rate of heat transfer may be found.

The temperature distribution in a wall through which heat is flowing in one direction only, is given by the following equation:

$$\frac{\delta t}{\delta \theta} = \frac{k}{rc}\,\frac{\delta^2 t}{\delta x^2} \qquad \text{.....(2)}$$

In this equation, t denotes temperature, θ time, and x position. The thermal conductivity, k, divided by the density, r, and the specific heat, c, has the units of sq. ft. per hr. and is called thermal diffusivity, a. In words, the equation states that the change of temperature with respect to time at a fixed position is equal to the product of thermal diffusivity and the change in the change of temperature with respect to position at a fixed time.

The authors have tried several methods of solving this equation. One is an approximate method, originally used, in part, by E. Schmidt, and explained in "Industrial Heat Transfer" by Schack. This method is easy to apply as it involves the use of arithmetic, only. For simplicity, the partial derivatives in Equation (2) may be replaced by changes of small, but finite, amounts. Then

$$\left(\frac{\Delta t}{\Delta \theta}\right)_x = a\left(\frac{\Delta^2 t}{\Delta x^2}\right)_\theta \qquad \text{.....(3)}$$

Since the temperature of the wall is a function of both time and position, let the time be divided into equal increments of $\Delta\theta$ hours and the thickness of the wall into equal increments of Δx feet. For convenience, a

TABLE 1. ABSORPTIVITY OF SOLAR ENERGY BY SURFACES OF VARIOUS COLORS

Color	Absorptivity
Very light	0.4
Medium dark	0.7
Very dark	0.9

double subscript will be used on temperatures, the first to denote time and the second position. Thus, $t_{n,m}$ denotes the temperatures after a passage of time of $n\Delta\theta$ hours from the reference time, at a position $m\Delta x$ feet from the outside surface of the wall. At any position, m,

$$\frac{\Delta t}{\Delta\theta} = \frac{t_{n+1,m} - t_{n,m}}{\Delta\theta} \quad \text{.....(4a)}$$

At any time, n

$$\frac{\Delta t}{\Delta x} = \frac{t_{n,m+1} - t_{n,m}}{\Delta x} \quad \text{.....(4b)}$$

and

$$\frac{\Delta^2 t}{\Delta x^2} = \frac{(t_{n,m+1} - t_{n,m}) - (t_{n,m} - t_{n,m-1})}{\Delta x^2} \quad \text{.(4c)}$$

From Equation (3), it follows that

$$\frac{t_{n+1,m} - t_{n,m}}{\Delta\theta} = \frac{a}{\Delta x^2}(t_{n,m+1} - 2t_{n,m} + t_{n,m-1}),$$

or $$t_{n+1,m} = t_{n,m} + \frac{a\Delta\theta}{\Delta x^2}(t_{n,m+1} - 2t_{n,m} + t_{n,m-1}) \quad \text{.....(5)}$$

For convenience, let

$$\Delta\theta = \frac{\Delta x^2}{2a} \quad \text{.....(6)}$$

Then,

$$t_{n+1,m} = \tfrac{1}{2}(t_{n,m+1} + t_{n,m-1}) \quad \text{.....(7)}$$

The last equation will give the temperature of the wall at any point except on the outside or inside surface. To illustrate the method of finding the temperature of the *inside* surface of the wall, assume that the wall is divided, for convenience, into *four* slabs. If the film coefficient of heat transfer from the inside surface of the wall to the room air is 1.65, then the rate of heat transfer is

$$\frac{q_4}{A} = 1.65\ (t_4 - t_R),$$

where t_4 = the temperature of the inside surface of the wall, degrees F, and

TABLE 2. PROGRESSION OF TEMPERATURE THROUGH A 12-IN. WEST WALL

(Absorptivity = 0.5; Thermal Diffusivity = 0.05 Sq. Ft. per Hour; Thermal Conductivity = 1 B.t.u. per Hr. Ft. Deg. F.; Approximate Solution)

Time of Day	Outdoor Air Temp., Deg. F.	Incident Solar Energy, B.t.u. per Hr. Sq. Ft.	Temperatures, Deg. F				
			Outside Surface t_0	t_1	t_2	t_3	Inside Surface t_4
10 A.M.	87.50	0	86.80	85.74	84.68	83.62	82.56
10.63	88.95	0	87.67	85.74	84.68	83.62	82.56
11.25	90.32	0	88.66	86.17	84.68	83.62	82.56
11.88	91.85	0	89.78	86.67	84.89	83.62	82.56
0.50 P.M.	92.80	52	93.23	87.34	85.14	83.73	82.64
1.13	93.69	92	96.49	89.18	85.54	83.89	82.76
1.75	94.72	130	99.74	91.02	86.53	84.15	82.94
2.37	94.80	162	102.23	93.13	87.58	84.73	83.35
3.00	95.00	192	104.56	94.90	88.93	85.47	83.88
3.63	94.92	208	106.05	96.74	90.19	86.40	84.53
4.25	94.62	209	106.52	98.12	91.57	87.36	85.21
4.88	94.20	189	105.64	99.05	92.74	88.39	85.94
5.50	93.64	126	102.16	99.19	93.72	89.34	86.60
6.13	92.99	70	98.47	97.94	94.27	90.16	87.20
6.75	92.23	26	94.19	96.37	94.05	90.73	87.61
7.37	91.41	0		94.12	93.55	90.83	87.67
8.00	90.52	0			92.47	90.61	87.52

t_R = the temperature of the room air, degrees F.

This rate of heat transfer must be the same as the rate at which heat is conducted through the last hypothetical slab of thickness, Δx ft., or

$$\frac{q_4}{A} = \frac{k}{\Delta x}(t_3 - t_4)$$

Then,

$$t_4 = \frac{1.65t_R + \frac{k}{\Delta x}t_3}{1.65 + \frac{k}{\Delta x}} \quad \text{.....(8)}$$

At the outside surface of the wall, incident solar energy is being absorbed, and there is a transfer of heat, by convection, either from the air to the wall, or vice versa, depending upon whether the air temperature, t_a, is greater or less than the temperature of the outside surface, t_0. The rate of heat reception at the outside surface is

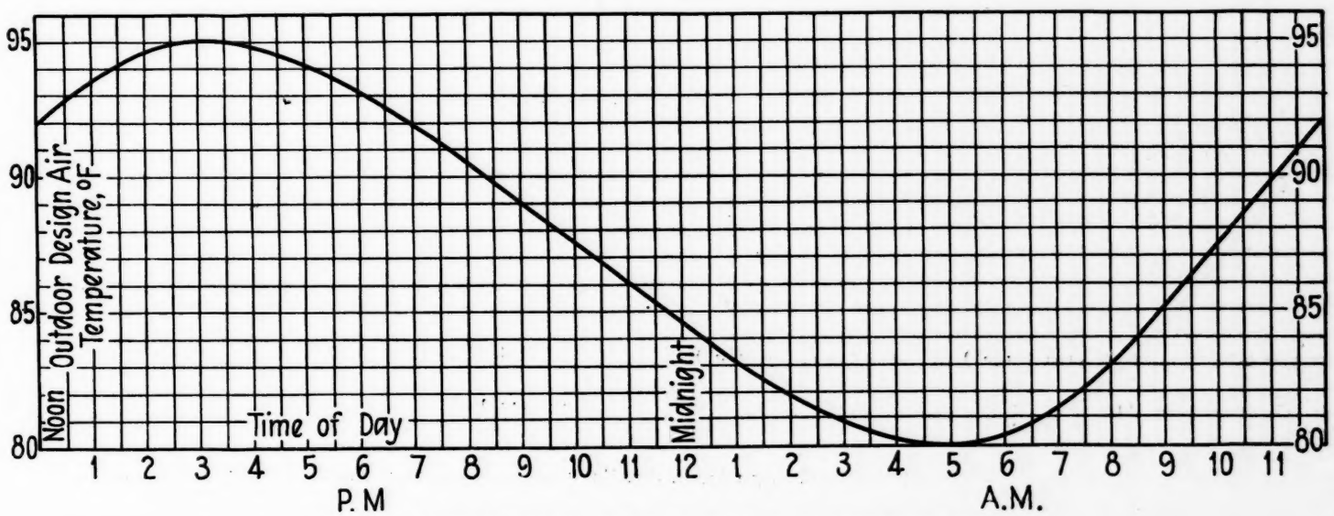


Fig. 1b. Assumed typical design outdoor air temperature variation.

$$\frac{q_o}{A} = bI + 6(t_a - t_o)$$

The rate of heat conduction through the first hypothetical wall slab is

$$\frac{q_o}{A} = \frac{k}{\Delta x}(t_o - t_1)$$

Since these rates are the same, the temperature of the *outside* surface of the wall is

$$t_o = \frac{bI + 6t_a + \frac{k}{\Delta x} t_1}{6 + \frac{k}{\Delta x}} \quad \ldots\ldots\ldots\ldots (9)$$

As an illustration of the approximate solution of the problem of temperature progression through a wall, consider a 12-in. wall, facing west. Assume for this wall that the absorptivity is 0.5, the thermal conductivity, 1.0 B.t.u. per hr. ft. deg. F, and the thermal diffusivity, 0.05 sq. ft. per hr. The corresponding value of $\frac{L^2}{a}$ is 20 hr. and of $\frac{k}{L}$, 1 B.t.u. per hr. sq. ft. deg. F. (These properties correspond closely to those of concrete, but the authors have not used the properties of specific materials in the general solution; with a general solution for materials of hypothetical properties, it is only necessary to substitute the known properties of actual materials to obtain a specific answer.) First, divide the wall into four slabs, each with a thickness of $\Delta x = 0.25$ ft. From Equation (6), the time increment is $\Delta\theta = \frac{(0.25)^2}{2(0.05)} = 0.625$ hr.

Assume that a constant air temperature of 80F is to be maintained within the room; then, the temperature of the inside surface of the wall is, from Equation (8),

$$t_4 = \frac{1.65(80) + 4t_3}{5.65} = 23.36 + 0.708t_3 \quad \ldots\ldots (10a)$$

The temperature of the outside surface of the wall is, from Equation (9),

$$t_o = 0.05I + 0.6t_a + 0.4t_1 \quad \ldots\ldots\ldots\ldots\ldots\ldots (10b)$$

As a reference point, assume that a steady flow of heat exists at 10 A.M.; at this time, the temperatures of the surfaces and at the two intermediate points in the wall are shown below:

Time	Temperatures, Deg. F					
	Outdoor Air t_a	Outside Surface t_o	t_1	t_2	t_3	Surface Inside t_4
10 A.M.	87.50	86.80	85.74	84.68	83.62	82.56

Next, the temperatures may be found after an elapsed time of 0.625 hr.; from Equation (7),

$$t_{1,1} = \tfrac{1}{2}(86.80 + 84.68) = 85.74$$

From Equation (10b), the temperature of the outside surface at 10.63 A.M. is $t_{1,0} = 0.05(0) + 0.6(88.95) + 0.4(85.74) = 87.67$. The rest of the table may be filled in, and the results are shown in Table 2.

TABLE 3. CALCULATIONS TO DETERMINE RATE OF HEAT TRANSFER THROUGH A WALL TO INDOOR AIR. DATA SHOWN APPLIES TO A 12-IN. WEST WALL.

Time, Hrs. After Noon, θ	Temperature Effect			Sum of Temp. Effect	Solar Radiation Effect					Rate of Heat Transfer q_3/A*
	Mean	Fund.	1st Harm.		Mean	Fund.	1st Harm.	2nd Harm.	Sum I Effect	
Noon 0	4.24	—1.86	—.15	2.23	3.54	—2.71	—.87	.43	.39	2.42
1	4.24	—1.47	—.10	2.67	3.54	—2.03	—1.46	.05	.10	2.72
2	4.24	—.98	—.01	3.25	3.54	—1.21	—1.65	—.36	.32	3.41
3	4.24	—.43	.06	3.87	3.54	—.31	—1.40	—.56	1.27	4.50
4	4.24	.16	.12	4.52	3.54	.61	—.77	—.43	2.95	5.99
5	4.24	.73	.16	5.13	3.54	1.50	.06	—.05	5.05	7.65
6	4.24	.91	.15	5.30	3.54	2.28	.87	.36	7.05	8.87
7	4.24	1.41	.10	5.75	3.54	2.90	1.46	.56	8.46	9.98
8	4.24	1.81	.01	6.06	3.54	3.32	1.65	.43	8.94	10.53
9	4.24	2.09	—.06	6.27	3.54	3.52	1.40	.05	8.51	10.52
10	4.24	2.22	—.12	6.34	3.54	3.48	.77	—.36	7.43	10.05
11	4.24	2.21	—.16	6.29	3.54	3.21	—.06	—.56	6.14	9.36
12	4.24	1.86	—.15	5.95	3.54	2.71	—.87	—.43	4.95	8.42
13	4.24	1.47	—.10	5.61	3.54	2.03	—1.46	—.05	4.06	7.64
14	4.24	.98	—.01	5.21	3.54	1.21	—1.65	.36	3.46	6.94
15	4.24	.43	.06	4.73	3.54	.31	—1.40	.56	3.01	6.23
16	4.24	—.16	.12	4.20	3.54	—.61	—.77	.43	2.59	5.49
17	4.24	—.73	.16	3.67	3.54	—1.50	.06	.05	2.15	4.74
18	4.24	—.91	.15	3.48	3.54	—2.28	.87	—.36	1.77	4.36
19	4.24	—1.41	.10	2.93	3.54	—2.90	1.46	—.56	1.54	3.70
20	4.24	—1.81	.01	2.44	3.54	—3.32	1.65	—.43	1.44	3.16
21	4.24	—2.09	—.06	2.09	3.54	—3.52	1.40	—.05	1.37	2.77
22	4.24	—2.22	—.12	1.94	3.54	—3.48	.77	.36	1.19	2.53
23	4.24	—2.21	—.16	1.87	3.54	—3.21	—.06	.56	.83	2.28

*$\frac{q_3}{A} = 4.24 + [2.24 \cos (15\theta - 146°) + 0.161 \cos (30\theta - 160°) + \ldots\ldots\ldots] +$

$b\,[3.54 + 3.54 \cos (15\theta - 140°) + 1.65 \cos (30\theta - 238°) + 0.561 \cos (45\theta - 320°) + \ldots\ldots\ldots]$

where

$\frac{L^2}{a} = 20$; $\frac{k}{L} = 1$; $h_o = 6$; $L = 1$ ft.; $k = 1$ B.t.u. per hr. ft. deg. F.; $b = 0.5$; $U = 0.565$ B.t.u. per hr. sq. ft. deg. F.;

$\lambda_0 = 0.54$; $\phi_0 = 86°$; $\lambda_1 = 0.32$; $\phi_1 = 130°$; $\lambda_2 = 0.17$; $\phi_2 = 157°$.

For a division of the wall into four slabs, the approximate solution shows a maximum temperature of the inside surface of the wall of about 87.7F at 7.15 hours after noon. This temperature corresponds to a maximum rate of heat transfer of 12.71 B.t.u. per hr. sq. ft. For the same wall, the time of maximum *steady* flow of heat is 3.91 hr. after noon, and the maximum rate of *steady* heat transfer is 18.24 B.t.u. per hr. sq. ft.; the time lag is, therefore, 3.24 hr.

This solution is approximate, for the answer depends upon the number of slabs into which the wall is divided. If the number of slabs is increased (Δx decreased), the time lag will be found to increase and the rate of heat transfer to decrease. An accurate solution would involve using several different values of Δx; the time lag and the actual rate of heat transfer to the indoor air may then be plotted against Δx; extension of these curves to $\Delta x = 0$ will give the accurate result.

Another solution of equation (2) which was used by the authors is that presented by Messrs. Alford, Ryan, and Urban in an article "Effect of Heat Storage and Variation in Outdoor Temperature and Solar Intensity on Heat Transfer Through Walls" in *Heating, Piping and Air Conditioning* for July, 1939. This solution is arrived at by the method of complex variables, and the result is expressed as a trigonometric series representing the rate of transfer of heat to the conditioned space. The calculating equation is:

$$\frac{q_2}{A} = Ut_m + U\left[\sum_{i=o}^{n} \lambda_i t_i \cos\ (\omega_i\theta - \delta_i - \phi_i)\right] + \frac{U}{h_o} b\, I_m + \frac{U}{h_o} b\left[\sum_{i=o}^{n} \lambda_i I_i \cos\ (\omega_i\theta - \zeta_i - \phi_i)\right] \quad \ldots\ldots\ldots (11)$$

where $\frac{q_2}{A}$ = the rate of heat transfer to the conditioned space, in B.t.u. per hr. sq. ft.,

U = the overall heat transfer coefficient of the wall, in B.t.u. per hr. sq. ft. deg. F,

h_o = the outdoor air film coefficient of heat transfer, in B.t.u. per hr. sq. ft. deg. F,

λ = a decrement factor which is a function of the wall properties,

b = the absorptivity of the surface,

ϕ = lag angle of transmitted heat wave,

θ = time, measured in hours after noon,

ω = angular velocity of sinusoidal waves, degrees per hour,

δ = displacement angle of outdoor air temperature wave referred to noon as zero, degrees (see air temperature series),

ζ = displacement angle of solar radiation wave referred to noon as zero, degrees (see solar radiation series),

t = temperature, deg. F, referred to constant indoor air temperature as zero (see air temperature series),

I = intensity of solar radiation, B.t.u. per hr. sq. ft. (see solar radiation series).

In applying equation (11), it is necessary that the variation of outdoor air temperature and of solar radiation incident on the various building surfaces be expressed in trigonometric series. The series used in this paper are:

For the outdoor air temperature

$$t = t_m + t_o \cos(\omega_o\theta - \delta_o) + t_1 \cos\ (\omega_1\theta - \delta_1) + \ldots\ldots\ldots$$
$$= 7.50 + 7.35 \cos(15\theta - 60°) + 0.86 \cos(30\theta - 30°) + .$$

(referred to a constant temperature of 80° in the conditioned space as zero)

and for the solar radiation

$$I = I_m + I_o \cos\ (\omega_o\theta - \zeta_o) + I_1 \cos\ (\omega_1\theta - \zeta_1) + \ldots\ldots\ldots$$

on the *West* wall

$$I = 37.6 + 69.8 \cos\ (15\theta - 54°) + 55.0 \cos\ (30\theta - 108°) + 35.2 \cos\ (45\theta - 163°) + 16.5 \cos\ (60\theta - 221°) + \ldots\ldots$$

on the *South* wall

$$I = 23.1 + 41 \cos\ 15\theta + 28 \cos\ 30\theta + 13 \cos\ 45\theta + \ldots\ldots\ldots$$

on the *East* wall

$$I = 37.3 + 69.3 \cos\ (15\theta - 305°) + 54.5 \cos\ (30\theta - 251°) + 35.6 \cos\ (45\theta - 195°) + \ldots\ldots\ldots\ldots\ldots$$

on a *Horizontal* surface

$$I = 96.4 + 148.9 \cos 15\theta + 59.0 \cos\ 30\theta + 2.1 \cos (45\theta - 180°) + \ldots\ldots\ldots\ldots\ldots\ldots\ldots$$

The values of the decrement factor, λ, and the transmission lag angle, ϕ, are found from charts similar to those shown in the article referred to on this method.

As an example of the use of this method, the same wall will be used as in the example of the use of the approximate method. When this is done the data in Table 3 result.

Both of these methods of solution were tried with walls of different assumed properties and gave substantially the same results.

The time lag (measured after the time of maximum *steady* flow of *heat*), and the actual rate of heat transfer (expressed as a fraction of the maximum rate of *steady* heat flow) depend upon the thickness of the wall (L), and the thermal conductivity, (k), thermal diffusivity, (a), and surface absorptivity, (b), of the building material. It is thus evident that in using the method given here for any actual wall, suitable values of the thermal diffusivity, of the thermal conductivity, and of the surface absorptivity of the building material must be known. The thermal conductance, k/L, must have the units of B.t.u. per hr. sq. ft. deg. F.

The thermal diffusivity is the ratio of the conductivity to the volumetric specific heat, expressed here in square feet per hour. In Table 4, values of thermal conductivity and diffusivity are given for building materials.

TABLE 4. THERMAL CONDUCTIVITY, k, AND THERMAL DIFFUSIVITY, a, OF BUILDING MATERIALS

Material	k B.t.u. per Hr. Ft., Deg. F	a Sq. Ft. per Hr.
Common Building Materials		
Brickwork	0.42	0.015
Concrete (sand and gravel)	1.0	0.045
Plaster (gypsum)	0.28	0.045
Stone	1.0	0.025
Tile	0.28	0.013
Wood		
Maple	0.10	0.004
Yellow Pine	0.07	0.004
Heat Insulating Materials		
Balsa wood (density 20 lbs. per cu. ft.)	0.048	0.007
Celotex	0.028	0.005
Corkboard	0.027	0.007
Glass wool	0.021	0.015
Masonite	0.027	0.005
Rock wool	0.022	0.015

An Inexpensive Solution of a Tricky Air-Conditioning Problem

By DARRELL R. NORDWALL†

HERE is how Mr. O. C. Johnson solved a rather interesting air conditioning and cooling problem in his mortuary located in Yuma, Arizona. This installation was made not to increase business but to preserve the owner's position as Yuma's leading embalmer. He reasoned that if people could be more comfortable while attending funerals held in his chapel, then his position as the number one mortician would be insured.

The building is separated into five divisions, namely, the clerical office, the workshop, the chapel, a small family room (where the immediate members of a deceased person's family can assemble in private) and the garage. (See Fig. 1.)

The owner wished to provide for two major conditions. First, to make it more comfortable for the employees in his office and his workshop to work during the extreme summer temperatures and second, to provide adequate cooling for both the family room and the chapel at times when funerals were being held. Inquiries disclosed that to obtain such results by means of the usual type of air conditioning would cost around $4,000, but a satisfactory solution was reached at a cost of only $2,000.

†Heating Section, Crane Co.

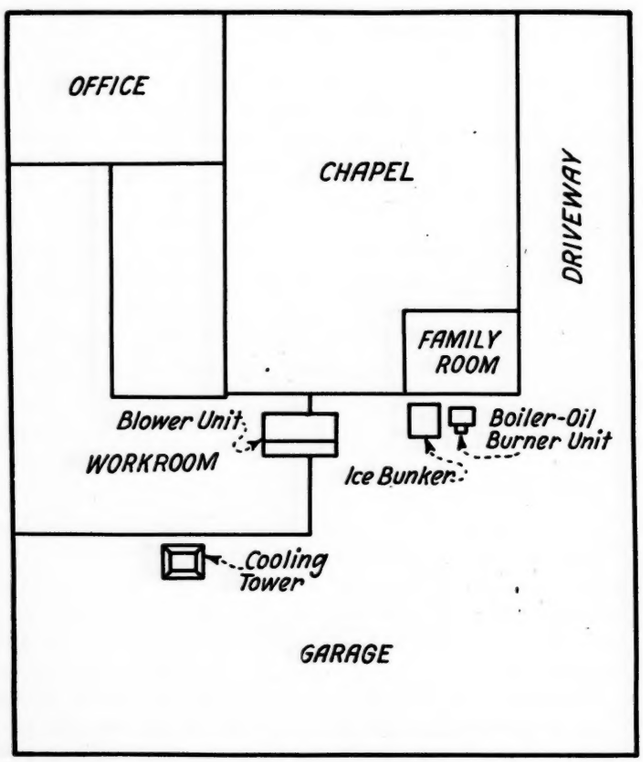


Fig. 1. Floor plan of mortuary.

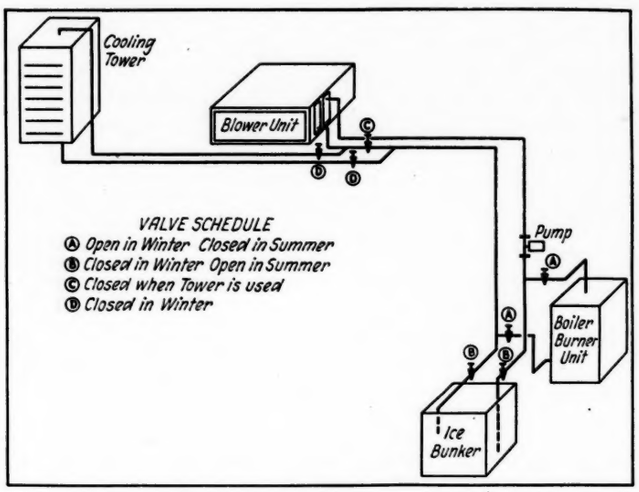


Fig. 2. Diagram showing method of heating and cooling used.

As illustrated in Fig. 2 this hookup consists basically of a water cooling tower mounted on the roof and using cooling by evaporation.

The second condition, that of providing adequate cooling during a funeral in the chapel, provided the toughest problem. This was largely due to the many variables that influence the comfort of people attending ceremonies in the chapel. For example here are a few: the atmospheric temperature outside on the day of the funeral, whether the services were to be held in the morning or afternoon (determining whether direct sun's rays hit chapel or not) and most important, how many people were to be present in the chapel.

The tremendous importance of this last factor may be realized when we consider each person in the chapel as a heat generator turning out around 400 B.t.u. every hour (a combination of both sensible and latent heat). This results in raising the temperature and the relative humidity due to evaporation of perspiration. So, in addition to external variables, we see that 50 guests would create 20,000 surplus heat units and 200 guests would run it up to 80,000. Thus it may be appreciated, that the installation that would successfully handle these variables must have great flexibility.

To accomplish satisfactory cooling for the fluctuating conditions, a tank, that can be filled with water and ice cakes, was placed in the basement. At such times as the chapel is in use and for a certain period ahead of time, the cooling tower is shut off and the load carried solely by the tank and ice. (See Fig. 2.)

Obviously it will take more refrigeration (measured in tons) to cool the chapel on a very hot day than on a merely warm day.

The flexibility of this system lies in the fact that all that is necessary to obtain more tons of cooling is to add more ice to the bunker tank (up to the capacity of the cooling coils on the roof).

The system is used during the winter season for heating the entire establishment by cutting off the cooling tower and bunker tank and feeding hot water to the coils on the roof. The same blower system then circu'ates warm air to all parts of the building. The boiler burner unit is controlled so as to supply hotter water on extremely cold days, while the blower fan is operated at constant speed during winter. The blower unit on the roof is provided with a two-speed motor to insure sufficient air changes during summer.

A number of interesting side-lights were noticed during the calculation of this job. One was that an extra cake of ice (800 lb.) has to be added for each additional 115 people attending a two-hour funeral. It was further determined that the heat gain was cut down 16% by equipping all windows with awnings. After the system was in service for a short period, it was found that by insulating the roof over the chapel with a 4-in. layer of rice hull ash, a saving of many tons of ice is effected every year.

A review of this installation shows that in addition to providing winter air conditioning, it gives two types of summer cooling. The first, using the cooling tower alone, will give a definite sensible cooling result by lowering the sensible heat but not controlling the relative humidity. Such an installation is economical in hot dry climates for large private homes, having a comparatively great amount of room space per occupant.

Second, by using the ice bunker and circulating iced water through the cooling coils both the sensible heat and relative humidity can be controlled.

The system has been tested under all sorts of conditions for four years and has successfully met every requirement.

Air Filters Tested for Effectiveness Against Bacteria

ENGINEERS have been interested for a long time in the effectiveness of air filters in removing airborne bacteria from the air. It has been generally assumed that filters having a high dust removal efficiency would be correspondingly efficient against bacteria, but this idea has been shown to be fallacious. Drinker and Wells early recognized the value of using pollen and bacteria for testing air filters but presented no extensive data to prove the value of the technique.

For some time the United States Public Health Service has been interested in this problem and working on it. The first results of their work have been published in an article in *Public Health Reports* for April 28. The work was done under the direction of J. M. DallaValle, passed assistant sanitary engineer, and Alexander Hollaender, biochemist, both of the Public Health Service, with the assistance of Richard S. Dill of the National Bureau of Standards, and under biological aide Roy C. Meinzer.

In this study, eight types of commercial filters were tested, the results of which are given in Table 1, reprinted from the publication referred to. Regarding the results of these tests the authors say:

"It will be noted that efficiencies are remarkably high considering the smallness of the organism. However, it must be held in mind that the efficiencies are not absolute. They apply to the conditions under which the tests were conducted. It must not be concluded that the efficiencies obtained will hold for all types of bacteria. When the longevity of the filter is considered, attention should be given to the nature of the medium itself with regard to its ability to favor or prevent bacterial growth.

"Table 1 further indicates that the variation in efficiencies for given filters does not vary greatly. Such variations as are noted in the table are due to inherent difficulties in handling and culturing bacteria. It is indeed doubtful whether filter efficiencies based on dust counts would be within such narrow limits. Variations in the initial concentration of bacteria upstream of the filter are also within fairly narrow limits. The concentrations are ideal for the conditions of the tests. Likewise, the effect of wide variations in concentration on efficiency does not appear to be marked. This is borne out by reference to test 4 where standard deviation of concentration is ± 30.7 colonies, while corresponding standard deviation of efficiencies based on the samples is ± 5.6 percent. Similar variations are to be noted in test 5."

TABLE 1.

Test No.	Type of filter	Number of tests	Average number of colonies per cubic foot of incoming air	Efficiency (percent)	Remarks
1	Felt cloth	6	71.5±12.9	63.5± 6.5	
2	do	6	42± 9.3	67.3± 6.5	
3	X-ply paper	3	[1]76.0	[1]31.4	Treated with oil.
4	do	8	92±30.7	74.8± 5.6	Do.
5	Y-ply paper	8	78.6±25.0	75.5± 8.0	Do.
6	Viscous impinging paper	7	38.8± 8.1	69.3±10.3	Treated with grease.
7	Steel wool (A)	7	20.8± 2.1	82.9± 7.6	2-inch thickness. [2]Treated with germicidal oil.
8	do	8	28.3± 7	85.4± 9.5	Do.
9	Steel wool (B)	3	[1]40.7	[1]77.6	Do.
10	do	8	31.9±10.3	73.5±12.6	Do.
11	Glass wool	7	27.6± 2.9	66.5±11.2	Oiled.
12	Glass fabric	6	72.7± 8.1	32.6± 8.3	
13	Animal hair	8	38.4± 5.3	45.8±12.3	

ABSTRACTS of Current Papers, Books and Pamphlets

Brass Pipe Handbook

The first edition of this book was published nearly 18 years ago, soon after the Copper and Brass Research Association was founded. Since then the book has found a useful place in the heating and plumbing field.

The present edition is made up of four main parts, the first giving general information on brass pipe such as the selection of suitable pipe, details of brass fitting and sizes and weights. The second part is entitled "Craftsmanship" and deals with cutting, threading and installing pipe, the use of pipe tools, making up joints and installation of brass and copper pipe. The third chapter is devoted to design and gives a large amount of information on design data. Chapter 4 is entitled "Layout" and takes up such points as layout of domestic water heater hookups, branch connections and heating and air conditioning systems. In the back of the book is a blueprint section in which there are numerous piping hookups of many typical applications.

[*"Brass Pipe Handbook," by T. N. Thomson, issued by the Copper & Brass Research Association, 420 Lexington Avenue, New York, N. Y. Cloth cover; 8½ x 11 in.; approximately 60 pages. Free when requested on business letterhead.*]

•

Heating and Ventilating Engineers Guide

The most noticeable change in this, the 18th, edition of the Heating and Ventilating Air Conditioning Guide is the physical appearance. To reverse the tendency toward constantly increasing bulk, the editors found it necessary to not only reduce the amount of repetitious material but also to make use of somewhat thinner paper and to eliminate a number of the problems in practice which appeared at the end of each chapter for several years. The result of these changes makes the book considerably lighter and thinner.

The only new chapter added is one which comes from the division of last year's chapter 22 into a new chapter 22 covering unit heaters, ventilators and humidifiers, and a new chapter 23 contains material on unit air conditioning, cooling units and attic fans. Numerous other chapters which have been rewritten or partially revised include those on Physical and Physiological Principles, Heat Transmission Coefficients and Tables, Heating Load, Central Systems for Comfort Air Conditioning, Air Conditioning in the Treatment of Disease, Radiant Heating, and some fourteen others. The Bulkeley Psychrometric chart which is attached to the inside back cover has been revised by replotting it to make it consistent with the Table of Properties of Saturated Water Vapor with Air which appears in chapter 1.

[*"Heating and Ventilating Air Conditioning Guide" published by the American Society of Heating and Ventilating Engineers, 57 Madison Avenue, New York, N. Y. Flexible cover; 6 x 9 in.; 792 pages in the technical section, 296 pages in the catalog section, and 96 pages in the membership section. Price, $5.*]

Psychrometric Readings

A mathematical method of computing the effects of radiation on the readings of thermometers is set forth by Dr. David Dropkin, in this bulletin of the Cornell University Engineering Experiment Station. The fact that neither the dry bulb nor the wet bulb thermometers, employed in the usual psychrometers for determining humidity in the air, indicate the true temperatures, because they may both be affected by radiation from surrounding objects, was pointed out in a previous bulletin from this Experiment Station. With specially designed apparatus, data have now been secured and equations developed to calculate the corrections for radiation of thermometers under varying conditions. It is well known that a thermometer, unshielded from radiation, and intended to measure the air temperature, may be greatly affected by surrounding objects which have a different temperature from that of the air. This makes it difficult to obtain the true temperature.

In Dr. Dropkin's bulletins, means for correcting observed temperatures are given which apply even to thermometer bulbs of different sizes. Such corrections are particularly important in attempting to get the relative humidity with the usual apparatus, since the key for obtaining the humidity is the difference between the wet bulb and dry bulb temperatures. Small errors in this difference make large errors in the results, so that the true moisture content of the air may vary considerably from that calculated from uncorrected thermometer observations. Dr. Dropkin found that under certain conditions, with low air velocities in a duct, the error in obtaining the difference in temperature of the two thermometer bulbs was as much as 39%.

[*"The Effect of Radiation on Psychrometric Readings," by David Dropkin. Published by Cornell University Experiment Station, Ithaca, N. Y. Bulletin No. 26. Paper cover; 6 x 9 in.; 60 pages; price, 60 cents.*]

•

Modern Blast Cleaning and Ventilation

Blast cleaning of metallic surfaces and particularly of castings is widely used in industry today. Because of the nature of the process each blast cleaning unit should have a modern ventilation and dust collecting system designed and constructed solely to meet the needs of the particular machine. According to the author, in the past proper ventilation has been treated too lightly by many industrial plant managers because they overlooked the fact that increased production, decreased machine maintenance and less occupational disease result from maintaining clean air in the blast enclosure.

While the purpose of this book is to serve as a practical guide to modern blast cleaning, it should be of considerable help to engineers engaged in the design,

construction and installation of ventilating systems for such machines. Approximately 40 pages of this 210-page book are devoted to this subject and in these 40 pages is much practical information on filters, ducts, dust collectors, fans, abrasive reclaimers, design of exhaust systems and maintenance of such systems.

[*"Modern Blast Cleaning and Ventilation," by C. A. Reams. Published by The Penton Publishing Company, Cleveland, Ohio. Cloth bound; 6 x 9 in.; 213 pages. Price, $4.*]

•

Effect of Tropics

In "White Settlers in the Tropics," the author, who is master of St. Marks College in the University of Adelaide, Australia, has produced a painstaking and scholarly research work covering the effect of climate, geography, geology, mental variations and other variables on whites of Northern European ancestors who have settled in the tropics.

In general the author reviews the experiences of these settlers from the earliest times and discusses the problem of the failures of white settlers in the tropics, the probability of their making progress eventually, and the hope for their ultimate success.

Broadly, the tone of the author's conclusions is skeptical but tempered by the suggestion that perhaps many of the variables working against white settlers are capable of control.

At the request of the American Geographical Society, the publishers, and with the consent of the author, Robert G. Stone, of the Blue Hill Meteorological Observatory at Harvard, has contributed highly numerous additional data, appendixes, and references. Without reflecting on the author's work it is probably true that to the air conditioning engineer Mr. Stone's appendixes and notes are the most interesting part of the book, since he is well acquainted with the problem of climate and has largely confined himself to this particular phase of the discussion.

Appendix I consists of eight pages of a particularly fine discussion of physiological research in its relation to acclimatization in the tropics and summarizes clearly the known information on effect of temperature on body functions. The second Appendix is a very fine review of comfort zones and includes numerous references to the work of investigators in all parts of the world in addition to the work done in this country. The third Appendix discusses "Cooling Power" which Mr. Stern defines as the net rate at which heat can be taken up from any body by its environment.

Both the author and Mr. Stone discuss their subjects in a completely dispassionate and objective manner. The book is to be highly commended, although the engineer would probably desire more concrete conclusions. Apparently, however, because of the inherent nature of the problem it is simply not possible to draw such conclusions.

[*"White Settlers in the Tropics," by A. Grenfell Price. Published by the American Geographical Society, Broadway and 156th St., New York, as Special Publication No. 24. Cloth bound; 7 x 10 in.; 311 pages. Price, $4.*]

Hot Water Heating

The use of hot water (above 212F) under pressure, instead of warm water (below 212F) for heating plants has many advantages for the plants with capacities of 12 to 16 million B.t.u. per hour. The cost of materials in hot water plants (230F) is about 20% lower than in the warm water (194F) of the same size. The cost of radiators is 11 to 24% lower while the cost of installation is about 21% lower. The power consumption for pumping hot water is only one-half that of the warm water plant, because of the lower quantity of water to be circulated and because the flow resistance decreases with the rising temperature.

The temperature of inlet water in long mains must be kept below the maximum allowable temperature of the radiator surfaces, because otherwise the use of special heat exchangers (injectors) is necessary and the cost of the plant becomes too high. The use of injectors also causes difficulties in the control from the central station. The power consumption of the pumps also increases. The most convenient water temperature seems to be 230F at the inlet and 160F at the outlet. The temperature of the radiator surface is thus 194F and, rarely, can rise to 230F; this temperature also seems admissible.

Hot water heating plants are especially advantageous when the heating central plant is combined with a power plant. In this case the outlet steam from the turbine can be used to heat the returning water of the heating plant.

The author gives in his article many plans and diagrams to support contentions discussed in this paper.

[*"Hot Water as Heat Transferring Agent in Heating Plants," by W. Spillhagen in Gesundheits-Ingenieur, page 403, July, 1939. Published by Verlag R. Oldenbourg, Munchen 1, Brieffach 31, price 0.75 RM, approximately 30 cents. Abstracted by Dr. Stephen Zamenhof.*]

•

Pump and Fan Design

In general features, the propeller pump is not a new development. Single-stage and multi-stage screw pumps with either constant or varying pitch propellers and with straightening vanes were introduced years ago, but application was restricted by difficulties in predicting the characteristics and in controlling cavitation. The design of propellers for airplanes has advanced rapidly in recent times, and application of the same principles to the design of propeller pumps and fans was inevitable. The present paper presents a complete method of design, including some corrections to previous work of the authors and others, and compares pump characteristics predicted by this method with measurements on a complete unit. Although no specific examples are given, the equations and methods developed here apply to fans if the compressibility of the air may be neglected.

[*"The Design of Propeller Pumps and Fans," by Morrough P. O'Brien and Richard G. Folsom. University of California Publications in Engineering, Vol. 4, No. 1. Published by University of California Press, Berkeley, Cal. Heavy paper cover; 8½ x 11 in.; 18 pages. Price, 50 cents.*]

BRIEF REVIEWS

DUSTS. An engineering survey of environmental conditions in 17 cement plants located in various sections of the United States. The survey showed that finished cement dust is often present in relatively high concentrations in the atmosphere of the finishing mills and packing departments but this dust contains practically no free silica. In the raw mills and associated crusher houses the air contains variable concentrations of dust ranging from 1 to 30% silica, and in a limited area in one plant, on occasion, as much as 60% free silica mixed with particles of limestone, shale clay and other materials. Technical obstacles prevented exact determination of the proportion of atmospheric silica that was present in inhalable state. It was shown, however, that much of it is too large to cause danger. In the quarries or mines, blasting and loading operations produce dust, which in occasional cases may be high in free silica. The hazard in quarries is generally slight because the natural ventilation is good and the exposures are intermittent. Also contains information on the results of physical and roentgenographic examinations on employees. [*"Survey in Seventeen Cement Plants of Atmospheric Dusts and Their Effects upon the Lungs of Twenty-two Hundred Employees," by L. U. Gardner, T. M. Durkan, D. M. Brumfiel and H. L. Sampson. Published in the Journal of Industrial Hygiene and Toxicology, September, 1939, pages 279 to 318. Journal published by the Williams & Wilkins Co., Mount Royal & Guilford Aves., Baltimore, Md. Price, single copies, 75 cents.*]

MECHANICS. Book is designed to provide the material for practical training in the application of all aspects of theoretical mechanics, including statics, kinematics, and dynamics. Statements brief but clearly worded on the principles and theorems of statics, kinematics, and dynamics are given at the beginning of the book. This section should serve as a useful reference on theory basic to all engineering training, as it contains a systematic summary of the subject. The rest of the book is devoted to a collection of practical problems selected to show how the principles of mechanics are used in the solution of actual engineering problems. Complete solutions are given in about 10% of the problems and answers are given for nearly all of the rest. [*"Problems in Mechanics," by G. B. Karelitz, J. Ormondroyd and J. M. Garrelts. Published by The Macmillan Company, 60 Fifth Avenue, New York, N. Y. Cloth bound; 6 x 9 in.; 271 pages. Price, $2.50.*]

RADIANT HEATING. Author presents a series of calculations and formulas for determining such factors in radiant heated rooms as the heat flow through outside walls, heat losses from ventilation and wall temperatures. [*"Radiation Heating from the Point of View of Physiology and Hygiene," by Prof. W. v. Bonzenbach. Schweizerische Bauzeitung, February 1939, page 71. Published by Verlag C. & W. Jegher, Zurich, Dianastrasse 5; price, approximately 25 cents. Abstracted by Dr. Stephen Zamenhof.*]

STOKERS. A service manual to aid retail coal merchants and domestic owners. Booklet outlines rules of procedure and describes stoker coals from the southern high volatile districts of eastern Kentucky, eastern Tennessee, southwestern Virginia and southern West Virginia. Other sections of the booklet deal with coal size, starting fire, fuel and air ratio, firebox draft, ash and clinker, frequency of cleaning fire, hold fire control, safety controls, room thermostat, night setting of room thermostat, the combustion process and suggestions for overcoming operation difficulties. A good fuel bed, a thin coke tree, a heavy coke tree and clinker in retort are effectively illustrated. [*"Stoker Etiquette," prepared by the Fuel Engineering Division of the Appalachian Coals, Inc., Transportation Building, Cincinnati, Ohio. Paper cover; 3¼ x 6¼ in.; 24 pages. Available on request.*]

HOT WATER CIRCULATION PUMPS. A description of the packing in hot water circulating pumps and of methods adopted to prevent leakage at stuffing boxes. [*"Hot Water Circulation Pumps," by R. Dummerbing, published in Die Warme, v. 62, 1939, page 159. Published by Reichsverband der Technischen Uberwachungs-Vereine, Technischer Verlag, Berlin SW 68. Price 1 RM, approximately 40 cents. Abstracted by Dr. Stephen Zamenhof, M.E.*]

OIL BURNERS. Commercial standard for automatic and mechanical draft oil burners designed for domestic installations which was accepted by the Oil Burner Industry Standards Committee as its standard of practice for new production beginning November 1, 1939. [*"Automatic Mechanical Draft Oil Burners Designed for Domestic Installations — Commercial Standard CS75—39." Published by the National Bureau of Standards, United States Department of Commerce. Paper cover; 6 x 9 in.; 24 pages. For sale by the Superintendent of Documents, Washington, D. C. Price, 5 cents.*]

COAL. This study was made to determine the suitability of Iowa coals for use in domestic stokers. The tests were made with a typical stoker-fired boiler in the laboratory; the results are directly applicable to the usual household installation. Relative costs of heating with Iowa and competitive out-of-state coals, clinkering tendencies and manual attention required when burning Iowa coals, soot and fly ash formation, and characteristics of mixtures of Iowa and high grade Eastern coals are reported. [*"Use of Iowa Coals in Domestic Stokers," by M. P. Cleghorn and R. J. Helfinstine. Published by the Iowa Engineering Experiment Station, Ames, Iowa. Bulletin No. 144. Paper cover; 6 x 9 in.; 40 pages. Available on request.*]

HOSPITAL AIR CONDITIONING. A general discussion of heating, ventilating and air conditioning of hospital buildings including some information on the most desirable system of heating and the temperatures to be maintained. [*"Air Conditioning in Hospitals," by E. Brezina in Gesundheits-Ingenieur, vol. 62, 1939, page 450. Published by Verlag R. Oldenbourg, Munchen 1, Brieffach 31, Germany. Price 0.75 RM, approximately 30 cents. Abstracted by Dr. Stephen Zamenhof.*]

PLASTICS. Catalog and directory issue of the magazine *Modern Plastics*. Designed to present in a complete form all of the available knowledge on the subject. Includes a plastics properties chart which is particulary noteworthy. [*"Modern Plastics" catalog and directory, October 1939, published by the Breskin Publishing Corporation, 122 East 42nd St., New York, N. Y. Plastic cover; 9 x 12 in.; 454 pages. Price, $2.*]

INDUSTRIAL VENTILATION. While this is primarily a code of recommended good practices for metal cleaning sanitation, it contains considerable information on the ventilation needed in metal cleaning processes. The subject matter in this code covers recommended practices and installations for alkaline solvent, solvent degreasing, metal pickling processes, tumbling mill, and abrasive blasting cleaning processes, as well as pertinent information on metal cleaning in general and on the prevention of accidents and minimizing exposure to occupational disease. [*"Code of Recommended Good Practices for Metal Cleaning Sanitation," published by the Industrial Hygiene Code Committee, American Foundrymen's Association, 222 West Adams St., Chicago, Ill. Heavy paper cover; 8½ x 11 in.; 53 pages. Price, $2.50.*]

INSULATION. Reprints of four papers presented at the Symposium on Thermal Insulating Materials, held by the American Society for Testing Materials, March 8, 1939. Papers included are: Factors Influencing the Thermal Conductivity of Non-Metallic Materials; A Discussion of Test Methods for Determining Physical Properties of Thermal Insulations; One Consumer's Problems in Selecting Heat Insulation and The Effect of Solar Radiation on the Heat Transmission Through Walls. [*"Symposium on Thermal Insulating Materials," published by the American Society for Testing Materials, Philadelphia, Pa. Paper cover; 6 x 9 in.; 123 pages. Price, $1.25.*]

REFRIGERATION COILS. A discussion of fin coils, their construction and application. Includes information on fin coil surface, heat absorption, tube size, coil selection, humidity, air movement and control fittings. [*"Analysis of the Rating and Performance of Fin Coils," by J. O. Schultz. Published by Rempe Company, 340 N. Sacramento Boulevard, Chicago, Ill. Mimeographed; 8½ x 11 in.; 8 pages. Available on request.*]

INSULATION. The structure, preparation, and previous data on the conductivity of silica aerogel are briefly reviewed. The failure of aerogel to block radiant heat adequately at high temperature and the need for an opacifying agent is discussed. Methods of addition of the silicon are discussed. The effect of the density of the aerogel on unopacified and opacified aerogel is shown. An increase in density of the aerogel causes greater opacity. This increase in opacity with density causes a lowering of conductivity with unopacified aerogel. If opacified the decrease is not so marked, since radiation is already well blocked by the opacifier. Since the conductivity of aerogel is less than that of air, a correct gradation of particle size of the aerogel to give maximum packing results in a low conductivity. A comparison of the values for silica aerogel and still air is given. Tests of aerogel as insulation for refrigerators show that condensation of moisture is prevented presumably by decreasing the diffusion rates in the insulating chamber. [*"Silica Aerogel," by J. F. White. Published in Industrial and Engineering Chemistry, Room 706, Mills Building, Washington, D. C., July, 1939, pages 827 to 831. Price, single copies, 75 cents.*]

REFLECTIVE INSULATION. A brief historical review of reflective insulation, including the theory, is presented. A summary of laboratory and service experience with reflective insulation covering a ten-year period is given, and the results show that this type of insulation is effective and permanent when properly installed under suitable conditions. A high insulating value is shown for this type of insulation when in a horizontal position with heat flow downward. A single reflective sheet placed midway in the air space of a flat roof can give an insulation value equivalent to 3 inches of corkboard if the direction of heat flow is downward as in the summer. With heat flowing upward through the same roof, the insulating value may be reduced to about 1 inch of corkboard. The importance of heat capacity of insulation for intermittently heated or cooled chambers is mentioned. The heat capacity of aluminum foil, as installed, is about one-fortieth that of an insulating material weighing 8 pounds per cubic foot. [*"Reflective Insulation," by Gordon B. Wilkes. Published in Industrial and Engineering Chemistry, Room 706 Mills Building, Washington, D. C., July, 1939, pages 832 to 838. Price, single copies, 75 cents.*]

COAL. Reprints of the papers presented at the 5th short course in coal utilization held at the University of Illinois, May 23-25, 1939. Among the papers are: What Is Behind the Heating Complaint?; The Smoke Problem; The Evaluation of Coal for Use in Domestic Stokers; Recent Improvements in Small Stokers; Taking Chances in Coal Sampling; The Designing of Domestic Boilers for Stoker Firing; The Stoker-Fired Warm-Air Furnace in the Research Residence; Domestic Stokers, and Trouble Shooting on Domestic Stokers. [*"Papers Presented at the Fifth Short Course in Coal Utilization." Published by the University of Illinois, Urbana, Ill., Engineering Experiment Station, circular series No. 39. Paper bound; 6 x 9 in.; 173 pages. Price, 50 cents.*]

INSULATION. The mechanism of heat flow in fibrous materials is considered and is applied to a few cases in the manufacture of heat-insulating materials. The heat insulation of large structures (walls and air spaces) is also considered and the part which conduction, convection, and radiation play in the heat transfer is discussed. Insulation by reflective insulation is considered in some detail. A few practical insulation problems are discussed. [*"Heat Insulation," by J. L. Finck. Published in Industrial and Engineering Chemistry, Room 706, Mills Building, Washington, D. C., July, 1939, pages 824 to 827. Price, single copies, 75 cents.*]

PUMPS. Specifications covering cast materials used in the manufacture of pumping equipment. [*"Material Specifications for Pumping Equipment," published by the Petroleum Market Group, Hydraulic Institute, 90 West St., New York, N. Y. Paper cover; 8½ x 11 in.; 16 pages. Price, 25 cents.*]

EDITORIALS

Saving Heat at the Windows

In most buildings a considerable part of the load in both heating and cooling equipment is due to our methods of construction which make use of window openings. This is a fact well-known to anyone who ever made an estimate of the load on any job. In spite of its importance being thus constantly drawn to attention, means of minimizing it have been surprisingly slow in coming into general use. We have had weather-stripping of good design and available at low cost for a long time, yet it has been rather slow in gaining acceptance. It is still safe to conclude that of all buildings built probably more are erected without any weather-stripping than with it. Much the same is true of detachable storm windows.

With the increased interest in summer cooling attention has been directed anew toward the window openings. As a result we have a few cases where window openings have been omitted entirely and some engineers are of the opinion that their omission will eventually prove to be generally acceptable to owners. Adjustable, fixed and portable awnings have been examined as a means of cutting off sun heat and while their effectiveness is admitted, still a great many cooling installations are made where no awnings of any form are present. More recently double glazed sash and awnings in the form of window screens have appeared but they are so newly available that the rate of acceptance can not be estimated.

Contrast this situation with the relatively rapid growth of the use of building insulation on exposed surfaces. While no definite figures are available it is believed that building insulation is more frequently used than are any of the means of reducing heat loads through window openings. It would appear that acceptance of window equipment is from 10 to 15 years behind that of building insulation in spite of many of the window devices having been in existence for years before much attention was directed toward insulation.

Just where the interests of those in this industry lie in connection with recommending the inclusion of heat-savers like insulation and window protectors is not always clear. Their use generally reduces not only the annual fuel consumption but the capacity of both cooling and heating equipment as well. One result is that any given building needs a smaller heating or cooling plant; hence, less equipment and less of the products for this industry. This situation has led some to question the value of promoting the use of these heat savers.

Such a conclusion and a course of conduct based on it is short-sighted. In the long run these heat savers can be expected to make means available whereby the purchaser can take advantage of better and more refined control equipment and can enjoy better performance from his plant and thus develop a good will and an appreciation of what heating and cooling performance means to him. This improved good will can be expected to more than counter-balance any losses due to reduction in equipment capacity on any one installation.

While this reasoning indicates a course of action generally, there is no denying at the same time that it will not always apply to each individual case. We believe that the best course to be followed is to keep fully posted on the costs and performance of the heat savers regardless of whether they are applied to walls or window openings and then to be able to make an analysis of what can be expected. Applying this information to the peculiarities of the job at hand permits making a recommendation which can be backed up by sound arguments. There is no use becoming either passionately attached to a steady recommendation of all heat savers regardless of merit any more than there is any use in closing the mind so tightly that their readily recognized merits are shut out.

◆

Support for Smoke Prevention

Report has it that St. Louis is on the point of taking steps which it is hoped will prove to be effective in eliminating its smoke nuisance. A proposal is that bituminous coal be processed before use to reduce its smoke producing characteristics to such a point that the nuisance will be done away with. Coal suppliers are to be encouraged to undertake this processing but if they fail to do so, it is proposed that the city provide equipment for the necessary processing. Such a plan is a decided innovation in smoke elimination methods as practiced in most cities. The usual plan has been to provide a smoke ordinance, inspection, a certain amount of instruction to consumers regarding methods of using smoke-producing coals, and fines for violations. The existing methods have been recognized as inadequate generally, even though their use has brought about some improvements over the former situation in some localities. It has long been recognized, too, that the smoke nuisance is something which can be eliminated almost wholly in any community whenever public opinion really reaches the point where truly effective measures will command the necessary support. All the discussion in St. Louis and the very fact that the plan as outlined is receiving a public airing are indications that perhaps the public there has finally reached the point where a more promising method of smoke elimination can be put into practice. Probably no other American city has suffered more than St. Louis from a most annoying nuisance and because of this no other city presents a better opportunity for demonstrating what can be done in smoke elimination if public opinion will support adequate measures.

HEAT CARRYING CAPACITY OF DUCTS FOR FORCED AIR

(When ducts are 4.7 to 17 in. in diameter and 300 to 750 f.p.m. velocity.)

CIRCULAR DUCTS	AIR TO BE HANDLED IN DUCT ▶	Up to 80 c.f.m.	81 to 90 c.f.m.	91 to 125 c.f.m.	126 to 175 c.f.m.	176 to 225 c.f.m.	226 to 260 c.f.m.	261 to 340 c.f.m.	341 to 480 c.f.m.	481 to 600 c.f.m.	601 to 1140 c.f.m.
	Velocity, f.p.m. ⟶	300	300	400	400	500	500	600	600	700	700
Diam. In.	RECTANGULAR DUCTS Dimensions in Inches	QUANTITY OF HEAT FLOWING B.T.U. PER HR. Register Temperature 140° F.; Return Temperature 80° F.									
4.7	3 x 6	3¼ x 6									
4.9	3 x 7	3½ x 6	3¼ x 7								
5.1	3 x 8	3½ x 7									
5.3					4 x 6						
5.7	3 x 9	3¼ x 8									
5.8	3 x 10										
5.9		3¼ x 9									
6.0		3½ x 9			4 x 7						
6.1					5 x 6						
6.2	3 x 11	3¼ x 10	3½ x 9								
6.3					4 x 8						
6.4	3 x 12										
6.5		3½ x 11	3½ x 10								
6.6					5 x 7						
6.7	3 x 13	4 x 9	3½ x 11		6 x 6						
6.8		3¼ x 12			4½ x 8						
6.9	3 x 14										
7.0		3½ x 13			4 x 10						
7.1	3 x 15	3¼ x 12	4½ x 9		5 x 8						
7.2		3½ x 14									
7.3		3¼ x 13	4 x 11		6 x 7						
7.4	3 x 16	3½ x 15									
7.5		3¼ x 14	4½ x 10		5 x 9						
7.6		3½ x 16	4 x 12								
7.7			3½ x 15								
7.8			4 x 13		4½ x 11						
7.9			5 x 9		6 x 10						
8.0	3 x 18		3½ x 16		7 x 7						
8.1		3¼ x 16	4 x 14		4½ x 12						
8.3	3 x 20		5 x 11		6 x 9						
8.4			4 x 15		4½ x 13						
8.5		3¼ x 20			7 x 8						
8.6			4 x 16		5 x 12						
8.7	3 x 22	3½ x 18	4½ x 14		6 x 10						
8.9					5 x 13						
9.0			4½ x 15		7 x 9						
9.1	3 x 24	3¼ x 22	6 x 11		8 x 8						
9.2		3½ x 20	4½ x 16		5 x 14						
9.5	4 x 18	5 x 15	6 x 12		7 x 10						
9.6		3½ x 24			8 x 9						
9.7		3½ x 22			5 x 16						
9.9			6 x 13		7 x 11						
10.0		3½ x 24	4 x 20								
10.1	3 x 30										
10.2	4 x 24	9 x 9									
10.3	7 x 14										
10.8	6 x 18	9 x 10	3½ x 26								
11.0	4 x 28	8 x 12									
11.1	6 x 17	7 x 14	5 x 12								
11.4		7 x 15	10 x 10								
11.5	4 x 30	6 x 18	8 x 13								
11.7	5 x 29		6 x 19								
11.8		7 x 16	9 x 12								
11.9	4 x 32		10 x 11								
12.0	4 x 28	6 x 20	8 x 14								
12.3	4 x 36		8 x 15								
12.4		6 x 22									
12.5	7 x 18		10 x 12								
12.6	6 x 20	6 x 23									
12.7	7 x 19	8 x 16	9 x 14								
12.9	8 x 28										
13.0	7 x 20	10 x 13	11 x 12								
13.1	6 x 25	8 x 17	9 x 15								
13.2	8 x 26	7 x 21									
13.3	8 x 21										
13.4	7 x 22		10 x 14								
13.5	6 x 27	8 x 18	9 x 16								
13.6			12 x 12								
13.7	8 x 28	7 x 23	8 x 19								
13.8	8 x 32										
14.0	6 x 29	8 x 20									
14.1	5 x 30		7 x 24								
14.2	6 x 30		12 x 13								
14.3	7 x 25	8 x 21	10 x 16								
14.6	7 x 28	8 x 22									
14.8	7 x 27		12 x 14								
15.0	9 x 20	10 x 18									
15.7		8 x 24	12 x 16								
15.8	7 x 28		14 x 14								
15.9	6 x 40	10 x 20									
16.0											
16.3	8 x 26										
16.4		7 x 30									
16.6	6 x 36		12 x 18								
16.8		10 x 22									
16.9	8 x 28		14 x 16								
17.0											

Published by HEATING & VENTILATING, *148 Lafayette St., New York* 3/40 *Copyright, 1940, by* THE INDUSTRIAL PRESS

H. & V.'s REFERENCE DATA—169

HEAT CARRYING CAPACITY OF DUCTS FOR FORCED AIR

(When ducts are 4.7 to 17 in. in diameter and 300 to 750 f.p.m. velocity.)

The table on the other side of this sheet is a modification of the relation between quantity of air flowing, area of the cross-section of the duct in which it flows, and the mean velocity of flow. A direct solution of this equation in terms of quantity of air and covering the same range of duct diameters and air velocities can be found on HEATING & VENTILATING's Reference Data Sheet 167-168. This table differs from that given in the Reference Data Sheets referred to in that it indicates the quantity of heat which is carried by the various air quantities.

Evidently a given quantity of air delivered to a room at some specified temperature gives up a definite amount of heat as it cools down during its passage through the room to be heated. The heat quantities in the table are computed from the air quantities when the register air temperature is 140F, when the air temperature at the breathing line is approximately 70F, and when the return air temperature is 65F. The computation under these conditions can be made as follows:

At 140F the density of air is 0.06615 lb. per cu. ft. The specific heat of air is 0.24. Therefore the heat given up by each c.f.m. of air in cooling from 140F to 65F is 0.06614 × 0.24 × (140-65) = 1.1905 B.t.u. per min. To convert this to B.t.u. per hour multiply by 60 and get 71.43 B.t.u. per hour. Thus each cubic foot of air gives up heat at the rate of 71.43 B.t.u. per hour.

The table is arranged to cover the velocities most frequently found in forced warm air heating ducts for air quantities up to 1250 c.f.m.

The list of rectangular ducts given includes all those commercially listed as *standard* by most manufacturers of ducts of the type supplied to contractors and installers. The rectangular ducts listed in bold face type are those which are commonly enough available by most makers of standardized ducts so that they can be considered as being *commercial sizes*. In the columns headed "Circular Ducts" the so-called commercial sizes are also shown in bold face type.

Examination of the equivalence of area between the circular ducts and the rectangular ducts will be found not to be exact in some cases. The reason for this is that some effect has been given to the fact that the ratio of width to depth of ducts has something to do with the carrying capacity.

It should also be noted that with the quantities flowing at the air speeds given, the frictional loss per 100 ft. of duct will fall between the limits of 0.06 and 0.08 in. of water gauge. This is the range of frictional losses usually considered suitable for the design of the usual forced air heating installation.

Example.—In a forced warm air heating system the heat loss from a certain room is found to be 35,700 B.t.u. per hour. With a design register air temperature of 140F and a return air temperature of 65F what commercial size rectangular duct should be used?

SOLUTION: From the table on the opposite side of this page it will be found that 35,700 B.t.u. falls between 35,429 and 35,951 which is under the column marked "341 to 549 c.f.m." Use the duct size opposite the 35,951 figure in the column and find that a 6 by 22 in. rectangular duct is the only commercial size duct that could be used.

While the table is thus based on one particular register air temperature Table 2 readily permits changing the heat quantity to that at other register temperatures.

TABLE 2

1	2	3	4	5	6
Entering Air Temp.	Room Temp. at 5 ft. Level	Return Air Temp.	Temp. Dif.	Ratio of B.t.u. per hr. to c.f.m.	B.t.u. capacity relative to B.t.u. capacity at 140° entg. Air Temp.
170	70	65	105	95.27	1.33
165	70	65	100	91.43	1.28
160	70	65	95	87.58	1.23
155	70	65	90	83.62	1.17
150	70	65	85	79.63	1.11
145	70	65	80	75.59	1.06
140	**70**	**65**	**75**	**71.43**	**1.0**
135	70	65	70	67.24	0.94
130	70	65	65	62.98	0.88
125	70	65	60	58.61	0.82
120	70	65	55	54.21	0.76
115	70	65	50	49.69	0.69
110	70	65	45	45.13	0.63
105	70	65	40	40.45	0.57
100	70	65	35	35.72	0.50
95	70	65	30	30.90	0.43
90	70	65	25	25.97	0.36

Published by HEATING & VENTILATING, *148 Lafayette St., New York.* 3/40 *Copyright, 1940, by* THE INDUSTRIAL PRESS

NEWS OF THE MONTH

Buffalo Council Prepares for $800,000 in A.C. Work in 1940; President Wants National Organization of Local Councils

BUFFALO—Installation of new officers, appointment of committees for the coming year and presentation of an honorary plaque to Past President Joseph Davis highlighted the Jan. 30 meeting of the Air Conditioning Council of Western New York.

Walter P. Davis, executive secretary of the council, introduced the new officers: Edwin R. Cooney, president; Richard H. Mollenberg, vice-president, and Lars Hedstrom, treasurer. Because of the absence of Past President Davis, who was ill, the plaque was presented by proxy.

Prior to announcing committee appointments, Mr. Cooney said: "This year we plan to see that every man in the council has a job to do and that he does it. This year we hope to do something about the air conditioning business in Western New York. The day of domination by the individual is past. We have got to work as a group."

Mr. Cooney said approximately $800,000 worth of air conditioning business would be done in Western New York in 1940 "and it's up to us to do it." He said the manufacturers are starting to make money and that it's high time the dealers got over on the profit side of the ledger.

Mr. Cooney then announced these committee appointments: Program, Sherman W. Strouse, The Trane Co., chairman; Joseph Davis, Davis Refrigeration Co., Inc., and D. J. Peterson, Minneapolis Honeywell Reg. Co.

Winter Air Conditioning: A. G. MacDiarmid, American Lubricants, Inc., chairman; Lars Hedstrom, General Air Conditioning Co. Inc.; H. L. Householder, Householder Heating Corp.; M. J. Rodman, Rodman Engineering Co. and Glen Bolton, Niagara, Lockport & Ontario Power Company.

Process Air Conditioning: DeWitt L. King, Niagara Blower Company, chairman; Roswell Farnham, Buffalo Forge Co.; L. N. Reed, Cooney Refrigeration Co., Inc.; R. L. Mollenberg, Mollenberg-Betz Machine Co., and W. A. Meiter, Worthington Pump & Machinery Corp.

Summer Air Conditioning: Mr. Mollenberg, chairman; Mr. Reed; J. K. Hawks, General Air Conditioning Co. Inc.; J. L. McDevitt, Joseph Davis, Inc.; G. H. Dietrich, McCarthy Bros. & Ford; John Minor, Coleman-Stratton, Inc.; A. L. Stevens, Mollenberg-Betz Machine Co.; H. J. Botchford, George W. Drake, Inc., and Mr. Meiter.

Automatic Heat: Joseph Collins, Frontier Engineering Corp., chairman; Mr. Householder and Mr. Hedstrom.

Air Conditioning Accessories: Arnold R. Kamman, A. R. Kamman Co., chairman; Walter Voisinet, John J. Nesbitt, Inc., and Mr. Peterson.

Publicity: Marshall Drake, George H. Drake, Inc., chairman; Charles A. Michie, Buffalo, Niagara & Eastern Power Corp.; C. E. Daly, *Buffalo Evening News;* George Foster, *Buffalo Courier-Express*, and A. E. Stratton, Coleman-Stratton, Inc.

Membership: Harold C. Day, American Radiator Co., chairman; C. P. Yoder, Buffalo, Niagara & Eastern Power Corp.; S. B. Howe, General Air Conditioning Co. Inc.; A. L. Colvin, Niagara, Lockport & Ontario Power Co., and Dr. N. W. Strohm, Medical Society of Erie County.

Finance: Mr. Cooney, chairman; Mr. Hedstrom, Marshall Drake, Mr. Mollenberg, Joseph Davis and A. E. Stratton.

Secretary Davis then took the floor and discussed the recent formation of the National Air Conditioning Association in Chicago which he attended. "I want to dispel any ideas regarding our participation as a council in this organization," Mr. Davis said.

"The men seeking this organization were in the contracting business. There were no dealers represented. It looked as though these fellows wanted a contractors' organization for their own purposes only."

Mr. Davis said he told the group that a national organization should be composed of delegates from the local councils all over the country. "I told them that the national group would have no efficacy in helping members of the trade solve their local problems.

"But it appeared that the contractors wanted to run the show so all I can say is, let them have it. The crying need in the air conditioning business today is not for a contractors' organization but for a strong national promotional outfit.

"They couldn't see it that way so we in Western New York are going to launch our own national promotional drive and finance it ourselves," Mr. Davis concluded.

Vernon Addresses Buffalonians

BUFFALO — J. R. Vernon, Johnson Service Company, Chicago, was guest speaker at the Feb. 12 meeting of the Western New York chapter of the ASHVE. Mr. Vernon discussed "Automatic Temperature Control for Air Conditioning Systems."

FHA to Emphasize Small Houses, Will Supply Promotion Material

WASHINGTON—The 1940 program of Federal Housing Administration puts special emphasis on stimulating the purchase of houses by families in the $1000 to $2000 a year income group —houses costing $3000 or less. This puts emphasis on construction of residences in lower cost brackets than heretofore.

As an added feature to the campaign, FHA aims to call public attention to how readily the low income family can get FHA financing. As a part of the educational work the administration has prepared a series of display material and literature available to all dealers and contractors who want to be identified with the program. This material includes window display pieces, consumer booklets, suggested local advertising copy, radio scripts, and colored movie film. Arrangements for securing any of this promotional material can be made by sending a request direct to Federal Housing Administration in Washington.

Birmingham Starts Anti-Smoke Drive

BIRMINGHAM—A committee to study Birmingham's smoke problems and make recommendations for a campaign of education and smoke control was appointed Jan. 22 at a meeting sponsored by the City Commission. Chairman of the committee is H. E. Hagood, city building inspector.

Discussions of the committee so far are looking toward city regulations covering new installations in homes and industries, to the end that the heating plants meet specifications for the elimination of smoke as far as possible. The city already has an ordinance regarding the density and amount of smoke that may be tolerated in a given time, and it is thought that this may be enforced more closely. In addition a campaign of education is planned to convince the public of the wisdom and economy of installing stokers where needed, or of using a smokeless fuel.

1939 Boston A.C. Up 27% Over '38

BOSTON — Air conditioning installations show a substantial increase in the Boston area served by the Boston Edison Company, which covers a radius of about thirty miles from Boston. The increase for 1939 was 27% over 1938, according to the company's air conditioning division. There were 460 installations and contracts signed, including the $3 million New England Mutual Life Insurance Building.

Ventilating of Tunnel Described

BOSTON—Members of the Air Conditioning Bureau met at the University Club Feb. 28, for the regular monthly dinner meeting. Guest speakers were William A. Reilly, Fire Commissioner of Boston, and A. L. O'Banion superintendent of the fire alarm division, Boston Fire Department. He was formerly engineer in charge of operation and maintenance of the Sumner vehicular tunnel, Boston, and therefore well qualified to speak on the subject, "Construction, Ventilation and Maintenance of the Sumner Tunnel." His talk included a discussion of the effect of carbon monoxide on human beings and was illustrated by slides of the construction and the ventilating equipment.

Report Heating Oil Sales Up 2%

WASHINGTON—Domestic deliveries of fuel oil declined 8% in 1938 compared with 1937, while the demand for kerosene was 2% higher in 1938 than in 1937, according to a survey made by the Petroleum Economics Division, Bureau of Mines, United States Department of the Interior in cooperation with oil distributors. Domestic fuel oil sales in 1938 of 407,850,000 barrels dropped from record deliveries of 441,803,000 barrels in 1937 and reached approximately the same level established in 1936.

Strike Averted at Housing Project

BUFFALO—A strike of steamfitters at the new Commodore Perry housing project here was averted when Joseph Davis, heating contractor, agreed to employ steamfitters instead of firemen at the project's central heating plant.

The decision was made at the request of the U. S. Housing Authority, Mr. Davis said, in order that further attempts to reach a satisfactory solution may be made. The action came after a stormy meeting of the Municipal Housing Authority at which the authority, on the advice of counsel, refused to undertake responsibility for paying the $1240 additional that would be required to use steamfitters instead of firemen for this purpose during the construction period.

Bill Attacks School Ventilation

ALBANY, N. Y.—Pending in the State Legislature here is a bill designed to remove the present arbitrary requirements for ventilating and air-conditioning schoolrooms and provide for "adequate" heating and ventilating facilities. Introduced by Assemblywoman Edith C. Cheney, Steuben County Republican, the measure was approved by the Assembly Feb. 21 and forwarded to the Senate.

Dry Wine Storage Room Insulated

LOS ANGELES — With dry wines requiring maintained temperatures on a more scientifically controlled scale than sweet wines and other stored beverages, the Bohemian Distributing Co. of Los Angeles has introduced a completely insulated dry-wine cask room as one of the interesting features of its new $250,000 plant which was opened February 10.

The insulated cask room is a walled-off 30 by 40 foot section of the 160 by 40 foot main winery of Fruit Industries, Inc., which represents one of the various departments of the 3½ acre Bohemian plant, including a rectifying room, bonded Government whiskey warehouse, general warehouse, main offices and distributing division.

Ceiling and outer wall of the cask room are heavily insulated, as are the other three walls insulated with rock wool. Dry wines only are stored in this special chamber, in which, according to Donald C. Jamison, laboratory superintendent of the winery, temperatures are maintained between 60 and 65F. Dry wines suffer in quality if temperatures are permitted to drop below 60F, Jamison explained, and best results are obtained if air conditions are held at 62F, with a variance of not more than three degrees in either direction. If the thermometer is permitted to rise to 70F bacterial growth in the wine is encouraged, which develop to the incubation stage between 75 and 80F.

Hospital A.C. Subject of Meeting

CAMBRIDGE, MASS. — The Massachusetts chapter of the ASHVE had for its guest speaker at the February meeting, Charles F. Neergaard, New York, consulting engineer in hospital planning, organization and management. His subject was "Hospital Air Conditioning." Drawing from his wide experience in planning and supervising the operation of hospital systems, he discussed the advantages and limitations of air conditioning from the viewpoints of the clinician and surgeon, the manufacturer of equipment, the consulting engineer, and the hospital operating engineer.

Crocker Talks to Detroit Chapter

DETROIT—Members of the Michigan chapter of the ASHVE were the guests of the Detroit Edison Company for the regular January meeting of the chapter. One hundred and fifteen were present.

J. H. Walker, of the Detroit Edison Company, introduced the speaker of the evening, Sabin Crocker, also of the Detroit Edison Company, who spoke on the Standards and Codes for Piping as applied to Welded Construction.

Kunen Addresses Boston Bureau

BOSTON — Officers for the ensuing year were elected at the annual business meeting of the Air Conditioning Bureau, as follows: President, Daniel Ricker, Air Conditioning Division, Boston Edison Co.; vice president, E. D. Johnson, Boston representative, Buffalo Forge Co.; secretary, D. M. Ramsay, Jr., Westinghouse; treasurer, Forrest V. Paige, Boston Edison; directors, to serve three years, George E. Fickett, Powers Regulator Company and W. J. Pritchard, Boston manager, Carrier Corporation.

Guest speaker was Herbert Kunen of Anemostat Corporation of America, who spoke on "Air Distribution Design." His talk dealt with air flow, distribution, duct design, sound control and air measuring instruments. He also demonstrated by means of eucalyptus and cigarette smoke, a new device for control and direction of air distribution in an air conditioned room. In the course of his talk Mr. Kunen said that the matter of friction by air flow in duct design has been quite neglected, while other matters have been given more attention. But friction in ducts plays an important part in both air flow and distribution, as well as sound control in air conditioning systems. The fact that ducts many times give unequal quantities of air, because there is the same friction loss on branches as on main ducts, has often been overlooked in designing a duct system, he said.

$205 Million Spent for FHA Heating

WASHINGTON—Modernization and repair loans insured by the Federal Housing Administration have crossed the billion-dollar mark, Administrator Stewart McDonald announced February 17. On February 12, property improvement loans insured by the FHA since June, 1934, aggregated $1,000,781,662.

The bulk of loans both in number and amount have been for improvement or construction of one to four-family dwellings. Based on figures for 1938 and 1939, 73% of the number and 65% of the amount of the loans went for work on these homes; multi-family dwellings accounted for 15% of the number and 18% of the amount of the loans; commercial and industrial buildings took 4% of the number and 8% of the amount; and farm homes and buildings 4½% of the number and 4% of the amount. There was a small percentage of loans for other types.

Based on the major item of expenditure reported for each loan, approximately $205 million has been used for heating, $75 million for plumbing, and $200 million for structural changes.

Plan Third Oregon A.C. Conference

PORTLAND, ORE.—A discussion of district steam heating, a session at which leading architects will present subjects of their own choice, and an open session for the general public, will be innovations at the third annual Oregon State Air Conditioning Conference at Corvallis, March 28-30.

Sponsored by the College, the conference is held on the campus in the school of engineering. Earl C. Willey, assistant professor of mechanical engineering, is general chairman.

An afternoon session will be devoted to the economics of operating a business, with emphasis upon the warm air heating business.

Condensation in Building Construction, a paper by Dr. J. E. Lodwick, the U. S. Forest Service, will be a highlight of the conference, as will be Zoning Your Heating System, by John Mueller, Payne Furnace & Supply Company.

Cooling Equipment and Its Application will be covered by Albert Freeman of the Western Engineering Company, Portland. B. W. Farnes, Control Equipment Company, will have charge of the open session for the general public the first evening, at which he will encourage and answer questions from the audience. C. M. MacGregor, Portland Gas & Coke Company, will lead a discussion on the subject of Installation Codes.

Outlet Grills, Their Choice and Application will be described by R. P. Dewey, Barber-Colman Company. Duct Design and Construction will also have a place on the program. Radiator Heating will be presented by J. F. McIndoo, Portland, while Herbert K. Kunen, Anemostat Corporation of America, will speak on Air Distribution Design.

254 A.C. Jobs in N.J. Region in '39

NEWARK, N. J.—A sharp increase in gas building heating installations in the area served by Public Service Electric & Gas Co. is revealed in the 31st annual report of Public Service Corporation of New Jersey as recently released here.

"Building heating gas sales," the report states, "continued in 1939 their record-breaking progress. There were sold for this purpose 2,943,948,700 cu. ft., or 26.51%, more than in 1938. During 1939 building heating installations increased 2,297. There were on the mains, at the end of 1939, 10,620 building heating installations."

An increase in air conditioning installations also was noted by the report, which revealed: "Summer cooling and ventilating installations in 1939 totalled 254 as compared with 241 in 1938, 223 in 1937 and 131 in 1936."

N.J. Seeks Burner Law Uniformity

CAMDEN, N. J.—Uniformity of South Jersey municipal ordinances governing oil burner installations is being sought by the recently-formed oil burner division of the Electrical League of South Jersey, according to announcement here by Clarence R. Falkner, chairman of the division, who revealed results of a survey indicating wide disparity in such ordinances of approximately 100 municipalities in the area.

Mr. Falkner declared that, under present conditions, blue prints and specifications of each municipality must be studied to meet requirements even before a permit can be applied for. Some municipalities have no ordinances covering rules of the National Board of Fire Underwriters. There also is wide variance in permit fees, he added, and some communities require installators to be established in business locally.

In an effort to correct the condition, Mr. Falkner has announced a meeting of dealers and installators would be held during the first week of March, with fire marshalls of Camden, Burlington and Gloucester county municipalities invited to attend. Meanwhile, a dealers' committee has been compiling a report on all existing ordinances pertaining to oil burner installations in the area.

Southern Cal. Moves A.C. Courses

LOS ANGELES—Increased demand for instruction in air conditioning subjects and heating and air-handling machinery has prompted the University of Southern California to move the air conditioning courses from its affiliate school, University College in downtown Los Angeles, to larger quarters on the main campus of the University at 34th St. and University Ave.

Coincidentally the scope of the class work has been increased to include two one-hour periods in air conditioning daily. Under the direction of Dr. Albert Hansen, the following subjects are offered: air conditioning systems and their relation to general comfort and health; heating, air handling and refrigerating machinery and equipment; air conditioning in relation to industrial process; automatic control of temperatures; humidity and recirculation.

Murphy Heads Contractors Alliance

CHICAGO—The Air Conditioning Contractors' Alliance held its annual meeting January 29. The following were elected: president, John J. Murphy; vice-president, W. D. Dresen; board members, Fred L. Lensing, Philip E. De Berard, John H. Knoll, William L. Wente, and John Reif.

Chicago Group Hears Howatt, Lewis

CHICAGO—The first 1940 meeting of the Illinois chapter, ASHVE, was held January 8 with 69 present for dinner. The speakers of the evening were John Howatt and Samuel R. Lewis.

Mr. Howatt opened the discussion with a general review of solar radiation, pointing out that this radiation presents difficulties to the air conditioning engineer in maintaining comfortable conditions in summer, and that new forms of construction such as glass blocks, have been developed to help solve these problems. He cited the various theories on how radiation travels through space, discussed the spectrum, and concluded by describing the method of conducting the solar radiation tests at the Research Laboratory of the ASHVE.

Mr. Lewis then gave an abstract of the Research Laboratory paper on heat gain through glass blocks and showed slides of several of the curves developed from the test data. He analyzed and interpreted the information from the standpoint of the man in practice, and indicated its usefulness to the air conditioning profession. He completed his analysis of the paper by giving his conclusions (which he stressed were his own), as follows:

1) Solar heat reception through glass blocks apparently is about half that through a single glass.

2) Solar heat reception through glass on east and west orientations per degree difference does not vary significantly for different locations;

3) Solar heat absorption through glass increases as the season wanes toward the fall of the year, due to decreasing elevation of the sun normal to the plane of the glass. That is, the sun can "see" farther into the room as its noon elevation decreases;

4) The *Guide* values for solar radiation are conservative.

Insulations Described at Toronto

TORONTO—Five speakers described the types and uses of insulation for buildings at the largely attended February meeting of the Ontario chapter, ASHVE, held recently in the Royal York Hotel. Harry H. Angus, Toronto consulting engineer, introduced the subject and later headed the lively discussion period. Speakers included R. M. Murray of Building Products, Ltd.; T. B. Buckley of Canadian Gypsum Co., Ltd., E. B. Sheffield of Armstrong Cork and Insulation Co.; J. A. Graham of Gypsum, Lime & Alabastine Co., Ltd., Paris; and W. C. Smith of the Cooksville Co., Ltd. The speakers each dealt with the type of insulation made by his firm, thus every type of insulation was dealt with by an expert.

"Registered Homes" Plan Begins

WASHINGTON — The Federal Home Loan Bank Board on March 2 launched its spring drive to build "Registered Homes" under the Federal Home Building Service Plan, as the American Institute of Architects and the Producers' Council issued a joint statement to the building industry outlining their efforts in support of the program.

The avowed objective of the Institute and Council, as co-sponsors of the Plan is "the re-establishment of public faith in the home building market." Asserting that home ownership "suffered severely during the late depression because of faulty planning, shoddy construction, insecure equities and unfavorable financing," they pointed out that the Federal Home Building Service offers a "constructive and practical approach" to the problem of producing houses of durable value.

FHA Issues Report on Foreclosures

WASHINGTON — Federal Housing Administrator Stewart McDonald reported February 25 on the financial position of FHA at the end of 1939. The feature of his report showed that charges against the FHA's home mortgage insurance reserves at the year-end still amounted to only a fraction of one per cent of its total business.

On December 31, the FHA had acquired from the beginning of its program 1,188 small home properties out of 465,730 mortgages paying premiums and amounting to $1.97 billion in original principal amount. Of these properties 753 were acquired during 1939, compared with 435 in preceding years.

Benjamin Natkin

KANSAS CITY — Benjamin Natkin, founder of Natkin Engineering Company, with offices in Kansas City, St. Louis, Tulsa, and Omaha, died January 1..

Mr. Natkin was one of the pioneers in the engineering, design and sale of vapor vacuum heating systems and enjoyed a national reputation throughout the industry. He was active in the ASHVE, and was president of the Kansas City chapter in 1922. Among his activities was the promotion and construction of the President Hotel in Kansas City.

He is survived by his wife, and two sons, Bertram Natkin, St. Louis, and Alfred Natkin, Tulsa.

The firm has been continued since Mr. Natkin's passing away by the various partners consisting of Henry Gould and Emil Haas, Jr., of the Kansas City office; Bertram Natkin and S. J. Shure of the St. Louis office, Alfred Natkin of the Tulsa office, and Henry Kleinkauf of the Omaha office.

Engineers Honored at Banquets for "Modern Pioneers"

NEW YORK—Living American inventors who are making progress possible were honored by the National Association of Manufacturers at a dinner held February 27 at the Waldorf Astoria Hotel. Fifteen hundred were present to honor the 19 Modern Pioneers who were selected from the nation at large. Prior to this national dinner, Modern Pioneer dinners were held during February in 13 different cities throughout the United States to honor 101 inventors selected in local areas. The inspiration for this series of events is the 150th anniversary of the founding of the American patent system.

Among those honored as Modern Pioneers and known in the heating and air conditioning industry are William B. Hodge, vice-president of Parks-Cramer Co.; Dr. Frederick G. Cottrell; L. M. Ellison, president of Ellison Draft Gage Co., Chicago; Frederick S. Denison, Minneapolis-Honeywell Regulator Co.; Willis H. Carrier of Carrier Corp.; and William H. Mason of Masonite Corporation, all of whom were cited for particularly outstanding achievements. Mr. Carrier was one of the 19 outstanding engineers selected from the nation at large.

Others honored as Modern Pioneers include Harold F. Hagen, vice-president of B. F. Sturtevant Co.; C. E. Mason of The Foxboro Co.; John M. Frank, president of Ilg Electric Ventilating Co.; Joseph Harrington, president of Harrington Heater Co.; Ira E. McCabe, chief engineer of Mercoid Co.; Harold W. Greider, director of research of The Philip Carey Manufacturing Co.; Harry B. Hull, air conditioning engineer of Frigidaire Division of General Motors Corp.; James Slayter, vice-president in charge of research of Owens-Corning Fiberglas Corp.; R. E. Hall, director of Hall Laboratories, Inc.; J. F. Lincoln and J. C. Lincoln, president and chairman of the Board of Directors, respectively, of The Lincoln Electric Co.; R. L. Beers, chief engineer of Detroit Stoker Co.; Max Spillmann, engineer of Worthington Pump & Machinery Corp.; T. R. Harrison, technical director of The Brown Instrument Co.; A. A. Criqui, chief engineer of Buffalo Forge Co.; A. M. Lane, president of Monarch Metal Weatherstrip Corp.; E. S. Pillsbury, president of Century Electric Co.; Hans Weichsel, chief engineer of Wagner Electric Corp., and W. W. Hicks, president of Wesix Electric Heater Co.

Sheet Metal Group Organized

CLEVELAND — The National Sheet Metal, Roofing, Heating and Air Conditioning Contractors Association was formerly organized at the Hotel Carter here on January 25.

N.Y. Licensing Bill Again Proposed

NEW YORK—Once again a bill on the licensing of air conditioning contractors in New York State has been introduced to the State legislature. The identical bill is up for action in the Assembly and the Senate.

These bills provide for the licensing of contractors and no contractor would be allowed to install an air conditioning system unless he were so licensed. The bills further provide for a State Board to supervise the licensing of contractors and call for a fee of $25 for a certificate of competency and an annual fee of $10 for a renewal of the certificate.

These bills were defeated in the last session of the legislature and probably will meet a similar fate in the present session.

New York Service Men Elect Reina

NEW YORK—New officers have been elected by the Refrigeration and Air Conditioning Guild, Inc., an organization of service and maintenance men in the refrigeration and air conditioning field in the New York metropolitan district. The following have been elected as officers for 1940: president, Theodore A. Reina; vice-president, O. Forsberg; secretary, William F. DeSpagna; treasurer, Nathan Meister; sergeant-at-arms, F. Fagon; regional vice-presidents, Brooklyn, A. Smith; Manhattan, R. C. Jones; Queens, T. E. O'Donohue; Bronx, H. Zysman and Nassau, S. Molinari.

Heating Law Approved by Toronto

TORONTO—Despite protests from property owners' associations, the Board of Control recently approved the proposed heating by-law which governs heating installations and major repairs. J. W. Bruce, one of the representatives of labor organizations which supported the by-law, contended that 24 lives have been lost in Toronto in the past ten years, all of which could have been saved had the city proper inspection. The Ontario chapter ASHVE approved the passing of such a measure and assisted in framing the regulations.

Frederick R. Still

NEW YORK—Frederick R. Still, vice-president of the American Blower Corporation, who had spent seventeen years here in charge of the firm's export business, with offices at 50 West Fortieth Street, died February 15 after an illness of three days. His age was 72.

Mr. Still was born in Saginaw, Mich., and joined the American Blower Corporation in 1887.

He leaves a widow, Mrs. Harriet Humphrey Still, and a son, Roscoe Wilson Still.

WITH THE MANUFACTURERS

Koppers Coal Company Opens Stoker Research Laboratory; Will Study Stoker Coals for House Heating

KEARNY, N. J.—The Koppers Coal Company has equipped a new stoker research laboratory here for study of household heating plants equipped with stokers. Walter Knox, formerly with the stoker division of Fairbanks, Morse & Company and the Whiting Corporation, is conducting the studies.

The project is not only headed toward the testing and improvement of the company's stoker coals and their performance, but is designed to add to available information concerning the operation of stokers.

Initial heating plant installations in the laboratory consist of a warm air furnace and a standard type steam heating boiler. Stokers being used in the first tests include one with a round retort and another with a rectangular retort. One has a continuous feed gear case and the other has an intermittent feed gear case.

A feature of this laboratory installation is said to be the number of automatic instruments which keep continuous records even when no observer is present. An example is the case of a stoker which has been on intermittent operation all night. When the operator arrives in the morning he weighs the coal, notes the amount of water used, examines the charts showing CO_2, stack temperature, etc. He is said to have everything for a practical efficiency calculation. He can determine at what time the stoker ran and at what time it was off, whether or not it made objectionable smoke, what the draft was over the fire, and what the windbox pressure was at all times. He also can see how the heat output, as indicated by evaporation, has varied as the stoker started and stopped. To facilitate this determination a boiler curve has been drawn up, plotting pounds of water evaporated against the steam pressure. An orifice is used in the steam line and for every rate of evaporation there is a definite pressure. In this manner the steam pressure, which is continuously recorded, indicates the rate of evaporation, or heat output of the installation at any time.

It is planned to take photographs of the fuel bed at regular intervals in order to provide a permanent chronological record of fuel bed appearance. This will be synchronized with the recording of the devices on the instrument panel.

Among subjects to receive early consideration in the laboratory tests are studies to:

Determine practical ways of eliminating common difficulties, study the adaptability of new coals for stoker use, make investigations of various types of treatment, determine the factors influencing coke formation, study means of controlling coking tendencies, determine fusion ranges suitable for domestic underfeed stokers, investigate effect of different feed and air settings upon individual coals, study overdraft needs of different coals, study means of minimizing or eliminating flyash, study the mixing of different coals toward improving burning characteristics, accumulate actual data for some standardization of firing instructions and check burning characteristics of competitive coals.

Fan Association Elects Stephan

CLEVELAND—The Propeller Fan Manufacturers Association held its annual meeting January 23, at the Hotel Cleveland, with all sections of the country represented. The association reports gratifying progress in its nation-wide campaign advocating certified ratings for propeller fans, so that the ultimate consumer will be sure of the capacity of any fans that he installs or specifies. The key note of the meeting was that the purchaser should insist on certified ratings, that air delivery on any propeller fan equipment he purchases shall be in accordance with the Standard Test Code.

The following were elected to office for the year 1940: A. R. Stephan, DeBothezat Ventilating Equipment Co., president; M. W. Bauer, Aerovent Fan Co., vice-president, and V. C. Shetler, secretary-treasurer.

Reports from all parts of the country indicate a good volume of ventilating business ahead in 1940.

George DeBothezat

NEW YORK—Dr. George DeBothezat, inventor and engineer, died February 2 in the New England Baptist Hospital.

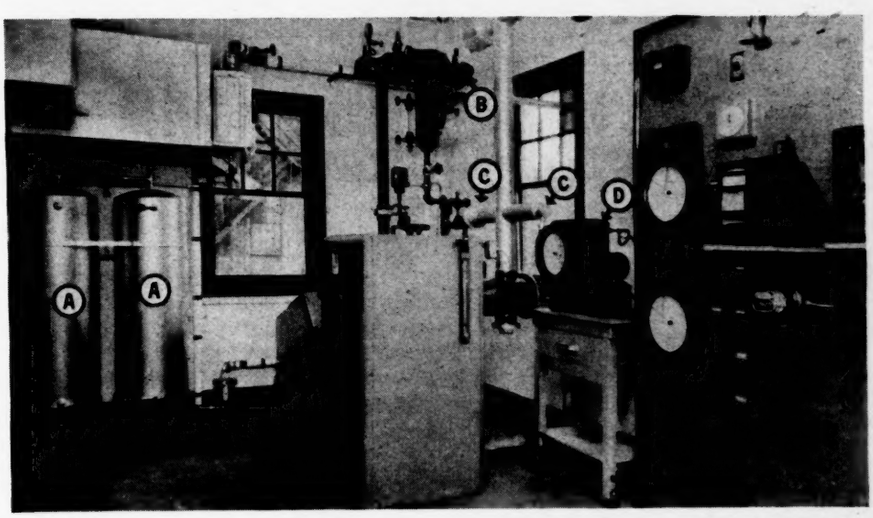
Dr. DeBothezat is best known for his invention of the helicopter and for his work in the field of aerodynamics and mathematical physics. Born in Russia in 1882, he served as professor at the St. Petersburg Polytechnic Institute under the czarist regime and later, under the Lenin government, taught young communists the rudiments of aeronautics. In 1920 he came to the United States and later became a naturalized citizen.

In 1923 Dr. DeBothezat built the first practical helicopter.

Dr. DeBothezat also applied his airfoil and blade-screw theories to the design of fans, and developed an axial flow fan which operated efficiently against static pressure and had a non-overloading power characteristic. In 1926 he organized the DeBothezat Impeller Corporation to market his axial flow fans, impeller blowers, and bifurcators. However, his primary interest lay in experimenting with aeroplanes of all types, and in 1934 he decided to devote all his time to work on the helicopter. The Impeller Corporation was taken over by American Machine and Metals, Inc.

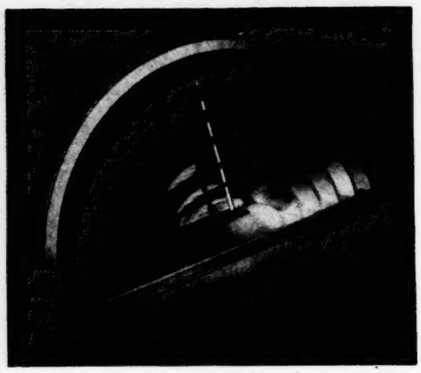
Boeddener to Promote Furnaces

NEW YORK—President C. A. Olsen, of the National Warm Air Heating and Air Conditioning Association, has appointed George Boeddener, Cleveland, as assistant to the president. Mr. Boeddener will spend most of the next few months in the field developing the merchandising and sales promotion work of the organization.



The stoker-fired steam boiler in the Koppers stoker coal laboratory. A—Calibrated water tanks from which water is fed to the boiler by compressed air. B—Calibrated orifice meter for continuously measuring steam produced. C—Standard light source and electric eye of smoke recorder. D—CO_2 recorder. At right is the instrument panel.

NEW EQUIPMENT



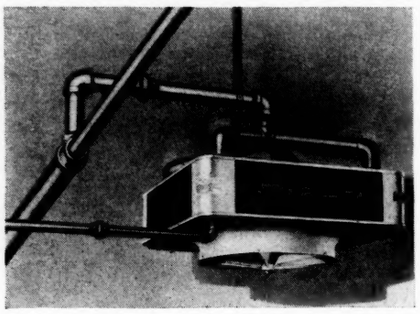
For introducing air without drafts.

Wall Type Anemostat

NAME AND MODEL NO.—Wall Anemostat, type W.
PURPOSE—For introducing air into rooms without drafts.
FEATURES — Device consists of a series of diverging semi-elliptical flaring members placed one within the other. The face of the device is mounted flush with the wall. It is stated that when the wall Anemostat is installed in connection with a duct system, the air which enters at a relatively high velocity is converted into a multiplicity of air currents traveling in layers or blankets in a variety of angles to each other. It is also claimed that at the same time, counter currents are created producing an aspiration effect which draws 35% of the room air into the device. This room air is mixed with the primary air and causes a rapid stabilization of the temperature in the conditioned space. Advantages claimed are draftless air diffusion and low velocity air turbulence throughout the enclosure, elimination of stagnant air pockets, even temperatures throughout the conditioned spaces, high outlet velocities permitting smaller duct work and a reduction in the number of outlets, and higher temperature differentials which permit a smaller air handling system.
SIZES AND CAPACITIES — 9 sizes with capacities ranging from approximately 32 to 3850 c.f.m.
MADE BY—*Anemostat Corporation of America, 10 East 39 Street, New York, N. Y.*

Modine Vertical Delivery Unit Heaters

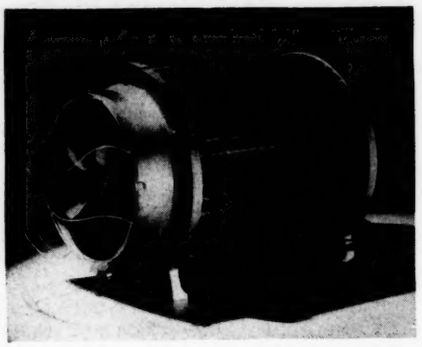
NAME—Modine vertical delivery unit heaters.
PURPOSE — For use wherever conditions call for more directly downward delivery of heated air than is provided by the conventional design of unit heaters.
FEATURES — Each unit is equipped with a radial or spoke-type deflector assembly known as the "Modine Cone-Jet Deflector." By manual adjustment of the individual deflector blades the delivered air may be concentrated in limited directions—even kept almost to the one side of the unit. Thus, in the multiple installation of Modine verticals, heated air deflection may be controlled so as to give more delivery of air to outside walls thereby conforming to normal heating requirements. By employing a steep angle of pitch on the deflectors, a high, narrow, jet-like cone of heated air may be thrown from a high elevation. When the unit is mounted relatively close to the floor the deflectors can be flattened for delivery of a low, broad cone of heated air. These unit heaters are built so they may be suspended directly from the supply branch without the use of hanger rods or straps. All Modine unit heaters are protected by the Bonderizing process.
LITERATURE AVAILABLE—Bulletin 140-A.
SIZES AND CAPACITIES—11 models, capacities from 30,000 to 471,600 B.t.u. per hr.
MADE BY — *Modine Manufacturing Company, Racine, Wis.*



Modine vertical delivery unit heaters.

Connor Odor Adsorber

NAME—Dorex odor adsorber.
PURPOSE—An adsorber for removing unpleasant odors, gases, vapors, smoke and fumes from places of human occupancy.
FEATURES — These odor adsorbers are available in two types, one, a portable unit and the other for installation in duct systems. Both units employ as an adsorption medium specially processed, highly activated, granular, coconut shell carbon. Manufacturer states that this activated carbon will hold more than 20% of its own weight of odors. Under normal conditions it is said to keep its high efficiency during several years of operation after which it may be reactivated. The portable unit which is known as the

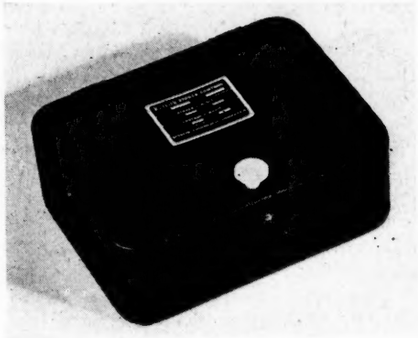


Portable odor adsorber.

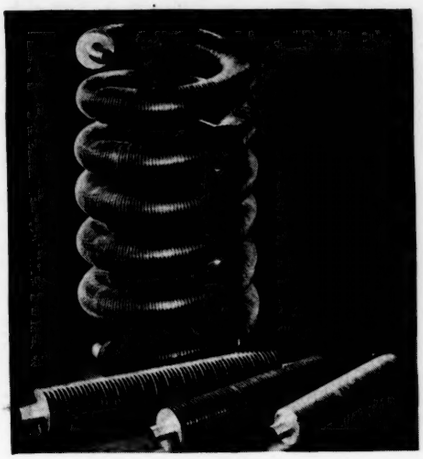
Squirrel cage type may be connected to any 110 volt electric outlet and has only one moving part, the electric motor which drives a small fan. The activated carbon in this unit is held inside a cylindrical shaped cage of closely spaced perforated metal cylinders. The unit which is designed to use in ventilating systems is installed in the air circulating system in the same manner as an ordinary dust filter.
MADE BY—*W. B. Connor Engineering Corp., Dorex Division, 114 East 32 St., New York, N. Y.*

Spencer Stoker Timer

NAME—KLIXON stoker timer.
PURPOSE—For controlling operation of stokers.
FEATURES—Timer is newly designed and is housed in an attractive metal container so that all operating parts are completely enclosed and protected from dust and interference. Stoker timer is non-mechanical in operation and does not contain magnet, gears or rotating parts. It is controlled by thermostatic disk working in conjunction with a laboratory calibrated heating element. Operating intervals for the timer can be set from ½ to 1 hr. Operating times vary from 2 to 7 minutes.
MADE BY—*Spencer Thermostat Company, 34 Forest St., Attleboro, Mass.*



No magnets, gears or rotating parts.



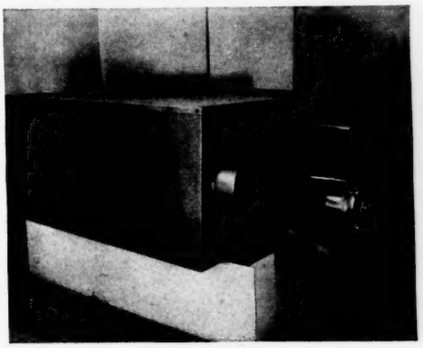
Chase spiral-fin tube.

Chase Extended Surface Tube

NAME—Chase Spiral-fin copper tube.
PURPOSE — For use in heating or cooling applications.
FEATURES — This tube is made in many sizes and fins come in varying heights, gauges and spacing. It is said that the spiral fins are cut in continuous lengths from thick wall tubing and each fin is smooth and flat. The fins are reinforced at the tube contact by two wires that are wound around the tube at the base and on both sides of each fin. By varying the height and spacing of the fins, the ratio of primary to secondary surfaces can be adjusted to best suit operating conditions.
SPECIFICATIONS—Tube sizes from ½ to 1¼ in. O.D. Fin heights from ¼ to ⅞ in. Fin thicknesses .008 to .020 in. Maximum tube diameter including fin, 2¼ in. Fin spacing, 4, 5, 6, 7 or 8 to each inch of tube. Fins either all tin-coated or plain copper with soldered joint.
MADE BY—*Chase Brass & Copper Co., Waterbury, Conn.*

Marlo Air Conditioning Units

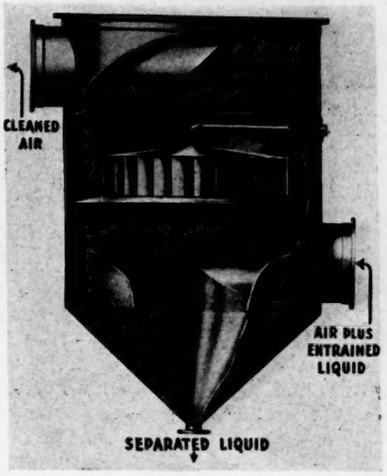
NAME AND MODEL NO.—Marlo air conditioning and industrial units, model C suspended type and model F floor type.
PURPOSE—For complete winter and summer air conditioning.
FEATURES—These units are designed to provide any part or all of the air conditioning functions using any common type of refrigerant or heating medium. Reasonable combinations of coil surface for air cooling or heating are available up to 12 rows. Manufacturer states that by these means and by changing blower speeds, complete flexibility is had to balance any reasonable combination of duty and air volume. Frames are made up of angle iron bent and electric welded. The blower scrolls, shaft bearings, motor base, coil condensate pan and filter section are all mounted on the frame members to support the weight and strain directly off the frame itself and in no case do the covering sheets or panels bear any loads. Frame assembly is primed and painted with a corrosion resistant lacquer. Interior surface is further coated with an emulsified asphalt-asbestos sound deadener and corrosion retardant. When insulated, units are provided with ½ in. thickness of insulation applied in emulsified asphalt-asbestos mastic and then coated with the same material so that the entire inside surface is protected against moisture absorption and yields a sound deadening effect. Fans are of the forward curve centrifugal type. Motors are equipped with an adjustable slide, rubber mounted on a base bolted to the frame of the unit. An adjustable V belt motor sheave facilitates adjustment of fan speed.
SIZES AND CAPACITIES—Both ceiling and floor unit available in 10 sizes with capacities ranging from 900 to 9500 c.f.m. at ¾ in. total static pressure with refrigerant capacities from 34,000 to 356,000 B.t.u. per hr., using a 40F refrigerant.
MADE BY—*Marlo Coil Company, 6135 Manchester Ave., St. Louis, Mo.*



Marlo air conditioning unit model C.

Schneible Entrainment Separator

NAME—Schneible Entrainment Separator.
PURPOSE—For recovering air borne liquids.
FEATURES—Manufacturer claims effective removal of atomized or entrained liquids arising from various processes or operations and drawn into a ventilating system. The separator is designed to remove free moisture from air ventilating — washing processes, pickling processes, plating processes and to extract oils, lacquers, solvents, coatings and other sprayed materials from ventilating air, to free conditioned air of excess moisture after washing and cooling, and for other vapor entrainment purposes. In operation, the unit is connected into the air intake duct so that air with its burden of liquid is passed through the unit. Air or gas entering the unit is rotated, separating larger liquid particles, and



Removes liquids from air.

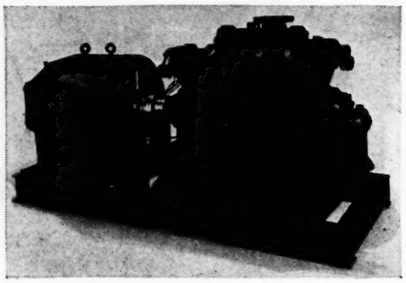
then passes through the turbine-like vanes to increase the centrifugal action and impingement growth of minute liquid particles. An anti-creep ring prevents creeping of oil and like liquids; the clean air passing on and out into the duct. Separated liquid drips down into a hopper at the bottom of the unit, from where it is drawn off for re-use, salvage or disposal. Often the bottom is connected to a sewer. The impingement unit can be flushed occasionally by means of a water or other liquid introduced just above the conical impingement plate section. Flushing liquid can be drawn off and salvaged or piped to a sewerage system or otherwise wasted so that it will not contaminate the recovered liquids.
MADE BY—*Claude B. Schneible Company, Chicago, Ill.*

Armstrong Unit Humidifier

NAME AND MODEL NO.—Unit humidifier type K-2A.
PURPOSE—For adding moisture to air.
FEATURES—Unit uses steam taken directly from a low pressure line (1 to 15 lbs. per sq. in.) or from a high pressure line through a reducing valve. Steam enters an outer jacket of the unit and is bled under the control of a solenoid valve into an inner chamber. From this chamber the steam flows to the atmosphere. A small electric fan mounted near the outlet helps spread the moisture through the surrounding space. Control is through a Friez humidistat connected to the solenoid valve. Capacity varies with the steam pressure used. With 7 lb. pressure manufacturer states that 43 lbs. of moisture per hr. can be added to the surrounding air without precipitation if the existing humidity is low and normal room temperatures maintained.
MADE BY — *Armstrong Machine Works, 846 Maple St., Three Rivers, Mich.*

Carbondale Refrigeration Compressor Unit

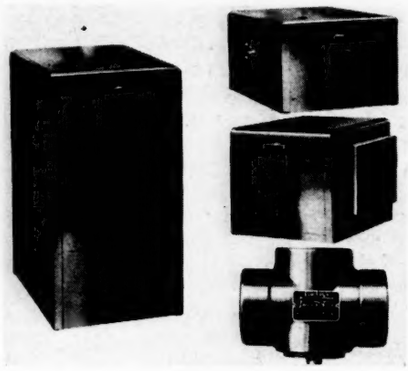
NAME—V type refrigeration compressor unit.
PURPOSE—For compressing refrigerant for air conditioning applications.
FEATURES—This unit utilizes a new 8 cylinder, V-type compressor designed for Freon 12 refrigerant. Manufacturer states that these units are compact, light in weight and provide a large capacity where floor space or head room is limited. They are built with either V belt or direct motor drive and can be supplied with either a horizontal shell and tube type condenser mounted on the unit or without the condenser for use with a Worthington-Carbondale Shower condenser.
LITERATURE AVAILABLE—Bulletin C-1100-B7..
CAPACITIES—From 75 to 125 tons for single unit and up to 250 for duplex arrangements.
MADE BY—*Worthington Pump and Machinery Corporation, Carbondale Division, Harrison, N. J.*



An 8-cylinder V-type compressor.

Kehm Hot Water Heating System

NAME—Force-Flo Adjustor system of hot water heating.
PURPOSE—For heating buildings using water as a heat carrying medium.
FEATURES—This is said to be a complete packaged heating system consisting of boiler-burner unit, distribution system and heating surface. The Master boiler-burner unit (available now in gas and with oil later) includes a new type gas burner and power unit of Thermak tubing, a circulating pump, relief and reducing valve, expansion tank, and complete control system all included within the cabinet. The unit is assembled and wired ready for installation and has a capacity of 120,000 B.t.u. The height is 33 in., width 20 in., and the depth 26 in. The distributional system employs an adjustable tee on each radiator with which it is possible to control the diversion of water to each radiator. When an installation is finished these tees are set by slotted screw at bottom of tee for correct balance. Calculation of pipe and radiator

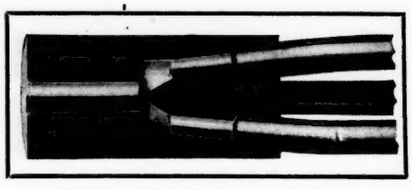


A complete packaged heating system.

sizes are said to be thus eliminated. In any installation up to 120,000 B.t.u. only ¾ in. mains and risers are necessary. It is said that only 4 sizes of radiators are required for any installation of this packaged unit up to 120,000 B.t.u. The system is also available with domestic hot water cabinets for summer operation and to include an indirect heater of any style or capacity desired. This unit comes with two control valves to stop circulation when pump is not running. Also available with a winter air conditioning cabinet into which is built Thermak coils, fan, filter, and operating controls with 175,000 B.t.u. capacity. This can be used as a supplementary conditioner or to make a split system.
MADE BY—*The Kehm Corporation, 51 East Grand Ave., Chicago, Ill.*

Spoehrer-Lange Refrigerant Distributors

NAME — Sporlan refrigerant distributor.
PURPOSE — For use on multi-circuit evaporators for evenly distributing liquid refrigerant to any number of circuits from 2 to 14.
FEATURES — These refrigerant distributors are to be used in conjunction with thermostatic expansion valves on multi-circuit evaporators. They are separate from the valves and can be applied to any standard evaporator in conjunction with any standard thermostatic expansion valves. They are available for any number of circuits from 2 to 14 and for connecting tubing from 3/16 to ⅝ in. OD. Distributor



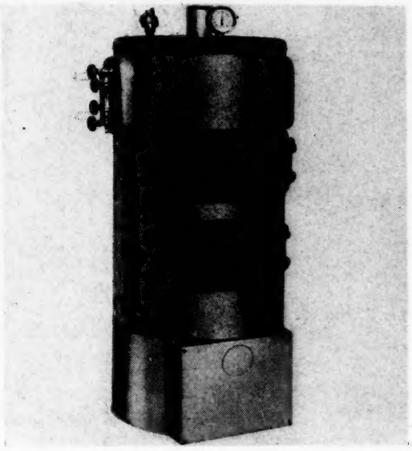
Reduces original and service costs.

consists of a brass body or housing one end of which is recessed to receive interchangeable bushings or nozzles. This nozzle increases the velocity of the refrigerant to reduce the effect of gravity and to center the flow so that it impinges squarely in the center of a cone shaped button at the opposite end of the housing. Evenly spaced around the base of the button are the orifices into which the refrigerant is evenly distributed. The connecting tubes carry the distributed refrigerant to the several circuits of the evaporator. The capacity of the distributor is governed by the size of the nozzle. Distributors are available without any connecting tubing or with any length tubing specified.
MADE BY—*The Spoehrer-Lange Company, 3723 Commonwealth Ave., St. Louis, Mo.*

For ventilating, air conditioning, and fume exhaust.

Sturtevant Blower

NAME—Rexvane Vent Sets.
PURPOSE—A general purpose blower or exhauster for general ventilating, air conditioning and fume exhaust.
FEATURES — These fans are of the centrifugal type with direct connected motor. A radial blade fan rotor is said to permit high rotative speeds, lower outlet velocities and more dependable balance when handling air which contains grease or solid particles. Cone shaped inlets are provided to guide inlet air to the rotor with a minimum shock and turbulence and consequent reduction in noise. Rotor consists of 8 blades, each of which is curved into the inlet in the direction of rotation. It is said that this design greatly increases the volume of air handled. Motors are of the NEMA specifications of 40° centigrade type.
SIZES AND CAPACITIES — 9 sizes with rotors ranging from 6 to 24 in. in diameter. Capacities from 250 to 6000 c.f.m. at ¼ in. static pressure.
LITERATURE AVAILABLE—Bulletin 406.
MADE BY—*B. F. Sturtevant Company, Hyde Park, Boston, Mass.*



No. 1733 Kewanee round steel boiler for oil burning.

Kewanee Steel Boiler

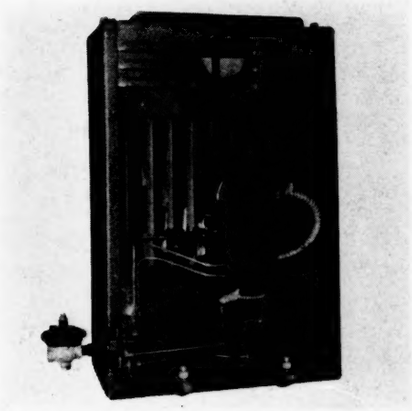
NAME AND MODEL NO.—Round type R steel boiler. No. 1733 for oil, and No. 0733 for stoker.
FEATURES—Outstanding features are said to be as follows: made of steel plate, models for oil or stoker come ready for quick assembly, proved efficiency up to 80%, two-pass tubes, water coil for domestic hot water ready installed, doors insulated with refractory lining or baffle liner, door castings with gas-tight ground joints or grooves sealed with asbestos rope gasket, and flues easily accessible from the front for cleaning.
SIZES—For use with steam systems, 275 sq. ft. radiator surface.
DISTRIBUTED BY—*American Radiator & Standard Sanitary Corporation, Pittsburgh, Pa.*

Mercoid Oil Burner Safety Control

NAME AND MODEL NO. — Mercoid Pyratherm type JM and JMI.
PURPOSE — For protection against flame and ignition failure.
FEATURES — Type JMI is for use with oil burners employing intermittent ignition while type JM is for constant ignition oil burners. These two devices are said to have two outstanding features. (1), the transformer repulsion-relay, which in principle is a low voltage transformer but also operates as a repulsion relay. It does not employ the conventional clapper type iron armature and is said to be not subject to residual magnetism. (2), a safety timing mechanism which provides a means for adjusting the period which a burner can operate without flame. Both controls are equipped with mercury contact switches. A two-wire hook-up is employed.
MADE BY—*The Mercoid Corporation. 4201 Belmont Ave., Chicago, Ill.*

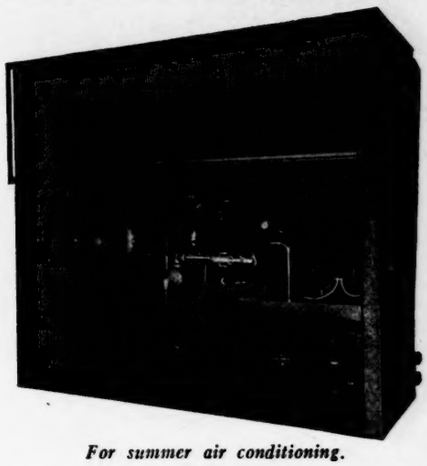
For protection against flame or ignition failure.

Schoedinger Gas Fired Unit Heater



Completely automatic unit heater.

NAME — FOSCO suspended type gas fired unit heater.
PURPOSE—For air heating using gas as a fuel.
FEATURES — Unit heater is of the suspended type and is completely automatic in operation. It is of two-speed, two-heat capacity type. Manufacturer states that it is possible to reduce the motor speed from 1140 r.p.m. to 825 r.p.m. and at the same time to automatically shut one burner off. This permits the heater to operate at reduced speed and heat capacity. It is said that air noises are eliminated when operated at the lower speed. Unit heater is supplied with room thermostat adjustable between 55 and 85F. Also included are an automatic safety pilot, pressure regulator, main shut-off valve and fan switch. The speed fan switch is provided on the heater to allow the fan to be operated during the summer.
SIZES AND CAPACITIES—Three sizes, S-90, capacity 90,000 B.t.u. per hr. single speed. S-2-90, 45,000 and 90,000 B.t.u. per hr., 2 speeds and S-180, 180,000 B.t.u. per hr. single speed. All capacities are input.
MADE BY — *F. O. Schoedinger, 322 Mt. Vernon Ave., Columbus, Ohio.*



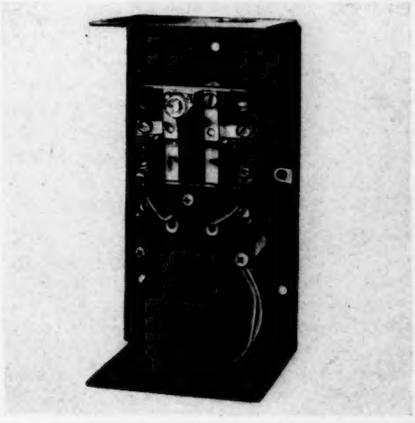
For summer air conditioning.

Curtis Air Conditioners

NAME—Curtis central type air conditioners.
PURPOSE—For summer conditioning.
FEATURES—These air conditioners are designed for large establishments where a short duct may be needed to obtain proper air distribution. Units are supplied complete and are said to be easily installed.
SIZES AND CAPACITIES—Available in 3 sizes with maximum compressor unit motor ratings of 9, 12 and 18 hp.
MADE BY—*Curtis Refrigerating Machine Company, St. Louis, Mo.*

Gleason-Avery Universal Relay

NAME—Gleason-Avery universal relay.
PURPOSE — For operating with any low voltage thermostat.
FEATURES—It is said that this relay will operate with any type low voltage thermostat and thus eliminates the need of carrying a number of different types of relays in stock. The relay is designed for use with automatic equipment requiring thermostatic control of 110 volt loads. The control circuit carries 25 volt current.
MADE BY — *Gleason-Avery, Inc., Auburn, N. Y.*



Interior of the G-A transformer relay.

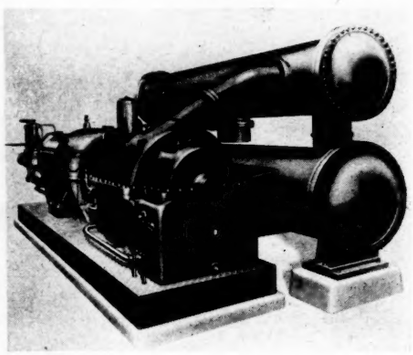
Hydraulic-action valve.

General Controls Valve

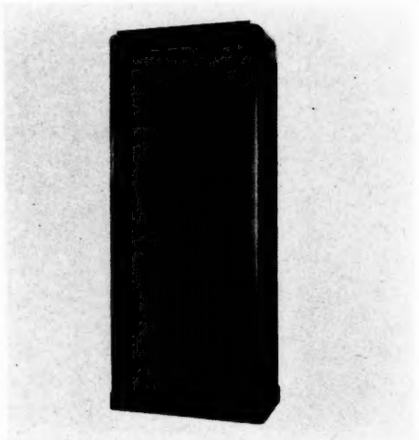
NAME AND MODEL NO. — Hydramotor G-2-1.
PURPOSE — For controlling the flow of liquids and gases.
FEATURES — Valve is operated by hydraulic action and is designed for use with fluids or gases such as water, air, gas, oil, gasoline, brine or steam. It is said that the valve will operate in any position and that the approximate opening time is 45 seconds and the approximate closing time is 10 seconds. No gears are employed and only one internal switch is used. Current consumption is said to be 60VA during opening cycle, 5VA when open. Valve is of single seated compression disc type.
SIZES AND CAPACITIES—From ½ to 4 in. I.P.S.
MADE BY—*General Controls Co., 700 W. Ivy St., Glendale, Calif.*

York-Allis Chalmers Turbo-Compressor

NAME—York-Allis Turbo-compressor.
PURPOSE—A steam or electric driven refrigeration compressor for air conditioning or refrigeration applications.
FEATURES—Compressor employs trichloromonofluoromethane or Freon 11 and can be driven with either steam turbine or electric motors. The condensers employed are of the non-ferrous, internal construction type while the water cooler is of the flash type with non-ferrous construction and hermetically sealed liquid pumps. Control systems vary with the type of prime mover employed. Direct drive, steam-powered compressors are equipped with governors for speed regulating. Secondary control of variable speed motors driving through speed increasing gears, permits similar flexibility when electricity is employed. Safety devices are provided to assure the constant flow of chilled water and to prevent freezing.
SOLD BY—*York Ice Machinery Corporation, York, Pa.*



York-Allis Chalmers Turbo-compressor.



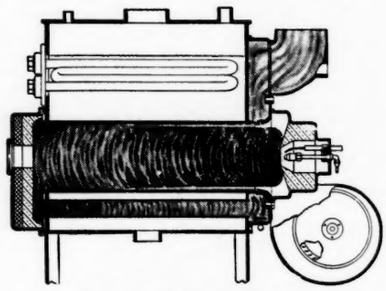
3 and 5 ton air conditioning units.

Peerless Air Conditioning Units

NAME—Peerless self-contained units.
PURPOSE — For summer air conditioning.
FEATURES — These units are complete except for compressor, motor and drive. They are equipped with large and removable panels which permit easy access to the interior. An ozonator is provided to purify the circulated air. Units are designed to take any 3 and 5 hp. compressor.
SIZES AND CAPACITIES—Two sizes —3 and 5 tons.
MADE BY—*Peerless of America, Inc., 515 West 35 St., Chicago, Ill.*

Duro Tension Indicating Wrench

NAME AND MODEL NO.—Tension indicating wrench No. 8099.
PURPOSE—For measuring the tension on bolts.
FEATURES—It is stated that this wrench will measure the tension on bolts to within 2% and is guaranteed to be within 5%. Manufacturer states that there are many applications for this wrench as for example, pulling up cylinder heads to a uniform tension. Wrench is available with a number of extension adaptors and off-sets for getting at bolts in inaccessible places.
MADE BY—*Duro Metal Products Co., 2649 North Kildare Ave., Chicago, Ill.*



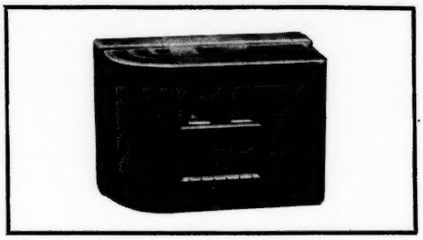
Compact boiler burner unit

Bethlehem Foundry Oil Fired Boiler

NAME—Dynatherm.
PURPOSE — For supplying steam or hot water utilizing oil as a fuel.
FEATURES—This oil fired boiler is shipped complete as a unit including all controls mounted and wired. The size of the crate is 20½ inches wide by 36 inches high. The oil is burned inside a central boiler tube and the gases pass through a multi-tube return before going to the stack. Instantaneous hot water coils are available if desired.
SIZES AND CAPACITIES—Three sizes with capacities ranging from 400 to 865 sq. ft. steam net load.
MADE BY—*Bethlehem Foundry & Machine Company, Bethlehem, Pa.*

M-H Chronotherm

NAME—Minneapolis-Honeywell Chronotherm T 111.
PURPOSE—Thermostat operating under time control.
FEATURES — Thermostat combines automatic time control with all of the features of the heat accelerated series 10 thermostat, and it is designed to operate with any Minneapolis-Honeywell series 10 primary control. Unit is equipped with a self-starting electric clock to automatically lower the temperature of night and to automatically restore the normal temperature at any time during the day. Additional features include, self-starting clock of the latest numeral type; co-ordinated temperature indicator and thermometer in parallel arrangement for comparative reading; Da-nite time recycling permits manual setting of temperatures at any time with automatic return to the regular time cycle at the next automatic temperature change.
MADE BY — *Minneapolis - Honeywell Regulator Company, Minneapolis, Minn*

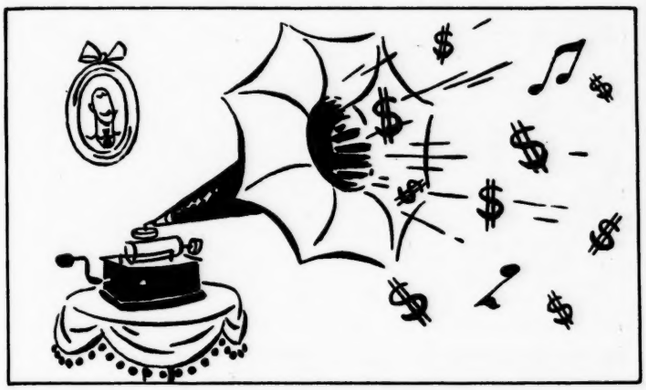


Combined thermostat and clock.

File this under "... New Installation ... Air Conditioning"

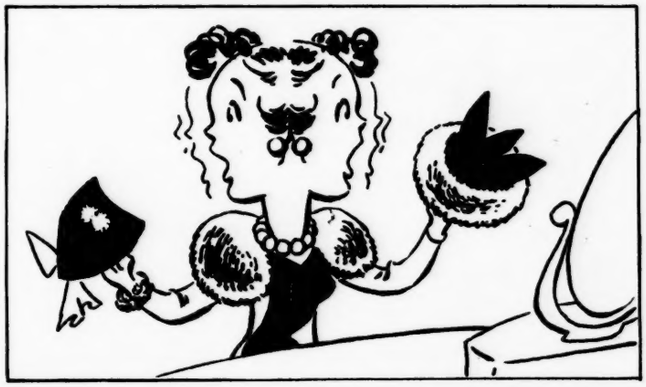
1 **To every worker** in the plant, you'll be tops in the management, now that you've decided to install air conditioning. Clean, properly conditioned air is just as necessary to worker-comfort and efficiency as non-skid floors, good light, and modern toilet facilities. *Congratulations!*

2 **And the brass hats** themselves will count you a Solomon for choosing efficient Dust-Stop* Air Filters for your new installation. Capacity: 2 CFM per sq. in. of area at 300 FPM. Resistance (in inches of water gauge per inch of depth): .045 to .050 clean to .11 to .12 dirty. They stop virtually all "nuisance" dusts!

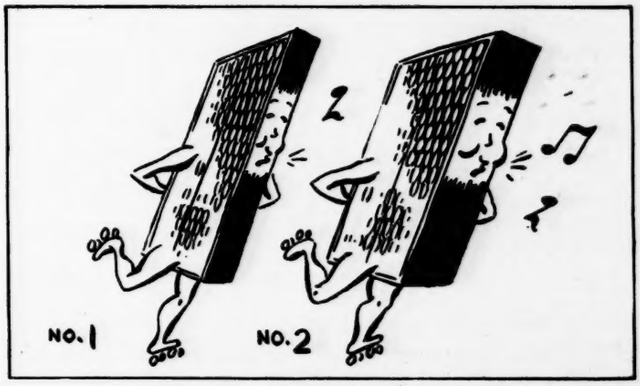


3 **And Dust-Stops will** declare dividends of savings for *you!* They cost approximately 1 cent per CFM to install, including frames—less than 1/10th cent per CFM when filters need changing. *Read on* for other advantages over permanent and mechanical filter installations!

4 **As far as Dust-Stops** go, you can send the plant firemen out into the fields to pick daisies. Dust-Stops are *safer* because the all-glass Fiberglas* filtering medium and the patented adhesive *will not support combustion.* But that's not all by a long shot. See picture 5.



5 **A woman couldn't** change her mind any easier than you can change Dust-Stop Air Filters. No skilled work required. These filters eliminate cleaning, charging, draining, expert supervision, and the need to keep a supply of spares. Dust-Stops fit all types of "L" and "V" frames, too.



6 **Your air conditioning** manufacturer, dealers and jobbers of this equipment everywhere, always have plenty of Dust-Stops on hand. You can get your supply of No. 1's (1-inch) or No. 2's (2-inch) at a moment's notice. So think it over, Mr. Plant Engineer, and specify *replaceable* Dust-Stops in that new installation.

FIBERGLAS* DUSTOP* AIR FILTERS

*T. M. REG. U. S. PAT. OFF.

Made by Owens-Corning Fiberglas Corporation, Toledo, Ohio

Degree-Day Figures for January, 1940

HEATING & VENTILATING continues its twelfth year of publishing degree-day data for various large cities

	Albany, N. Y.	Atlanta, Ga.	Baltimore, Md.	Birmingham, Ala.	Boston, Mass.	Buffalo, N. Y.	Burlington, Vt.
Degree-days for January, 1940.....	1549	1109	1208	1068	1303	1454	1654
Degree-days, Sept. 1, '39 to Jan. 31, '40	4285	2214	2728	2057	3452	3822	4713
Degree-days, Sept. 1, '38 to Jan. 31, '39	3818	1654	2303	1463	3079	3444	4280
Degree-days, Sept. 1, to Jan. 31, Normal	3726	1813	2619	1502	3280	3612	4202

	Cheyenne, Wyo.	Chicago, Ill.	Cincinnati, Ohio	Cleveland, Ohio	Columbus, Ohio	Denver, Colo.	Des Moines, Iowa
Degree-days for January, 1940.....	1435	1511	1426	1410	1466	1264	1694
Degree-days, Sept. 1, '39 to Jan. 31, '40	3861	3519	3211	3387	3366	3032	3771
Degree-days, Sept. 1, '38 to Jan. 31, '39	3942	3123	2553	2919	2763	3125	3228
Degree-days, Sept. 1, to Jan. 31, Normal	4104	3487	2795	3366	3133	3355	3762

	Detroit, Mich.	Dodge City, Kan.	Duluth, Minn.	El Paso, Tex.	Erie, Pa.	Evansville, Ind.	Fort Wayne, Ind.
Degree-days for January, 1940.....	1431	1497	1764	696	1427	1411	1564
Degree-days, Sept. 1, '39 to Jan. 31, '40	3706	3141	4781	1656	3533	3001	3739
Degree-days, Sept. 1, '38 to Jan. 31, '39	3366	2580	4920	1599	3085	2231	3136
Degree-days, Sept. 1, to Jan. 31, Normal	3584	3068	5161	1667	3336	2494	3405

	Fort Worth, Tex.	Grand Rapids, Mich.	Green Bay, Wis.	Harrisburg, Pa.	Hartford, Conn.	Indianapolis, Ind.	Ithaca, N. Y.
Degree-days for January, 1940.....	935	1395	1585	1336	1416	1495	1448
Degree-days, Sept. 1, '39 to Jan. 31, '40	1686	3609	4131	3260	3671	3357	3939
Degree-days, Sept. 1, '38 to Jan. 31, '39	1332	3278	3918	2945	3204	2725	3582
Degree-days, Sept. 1, to Jan. 31, Normal	1406	3659	4420	3069	3316	3130	3706

	Kansas City, Mo.	Knoxville, Tenn.	La Crosse, Wis.	Lansing, Mich.	Lincoln, Neb.	Little Rock, Ark.	Los Angeles, Calif.
Degree-days for January, 1940.....	1616	1189	1675	1453	1736	1115	166
Degree-days, Sept. 1, '39 to Jan. 31, '40	3273	2559	4118	3909	3643	2236	284
Degree-days, Sept. 1, '38 to Jan. 31, '39	2493	2068	3827	3590	2897	1703	515
Degree-days, Sept. 1, to Jan. 31, Normal	2903	2298	4313	4001	3512	1798	750

	Louisville, Ky.	Madison, Wis.	Memphis, Tenn.	Milwaukee, Wis.	Minneapolis, Minn.	Nashville, Tenn.	New Haven, Conn.
Degree-days for January, 1940.....	1382	1675	1176	1530	1816	1242	1304
Degree-days, Sept. 1, '39 to Jan. 31, '40	3012	4007	2322	3696	4481	2586	3414
Degree-days, Sept. 1, '38 to Jan. 31, '39	2303	3713	1682	3432	4235	1950	3013
Degree-days, Sept. 1, to Jan. 31, Normal	2526	4258	1871	3984	4550	2175	3219

	New Orleans, La.	New York, N. Y.	Norfolk, Va.	Oklahoma City, Okla.	Omaha, Neb.	Peoria, Ill.	Philadelphia, Pa.
Degree-days for January, 1940.....	683	1239	1054	1245	1761	1602	1227
Degree-days, Sept. 1, '39 to Jan. 31, '40	1089	3097	2267	2387	3794	3636	2944
Degree-days, Sept. 1, '38 to Jan. 31, '39	709	2672	1696	1928	3072	3059	2532
Degree-days, Sept. 1, to Jan. 31, Normal	735	2909	1933	2244	3639	3606	2736

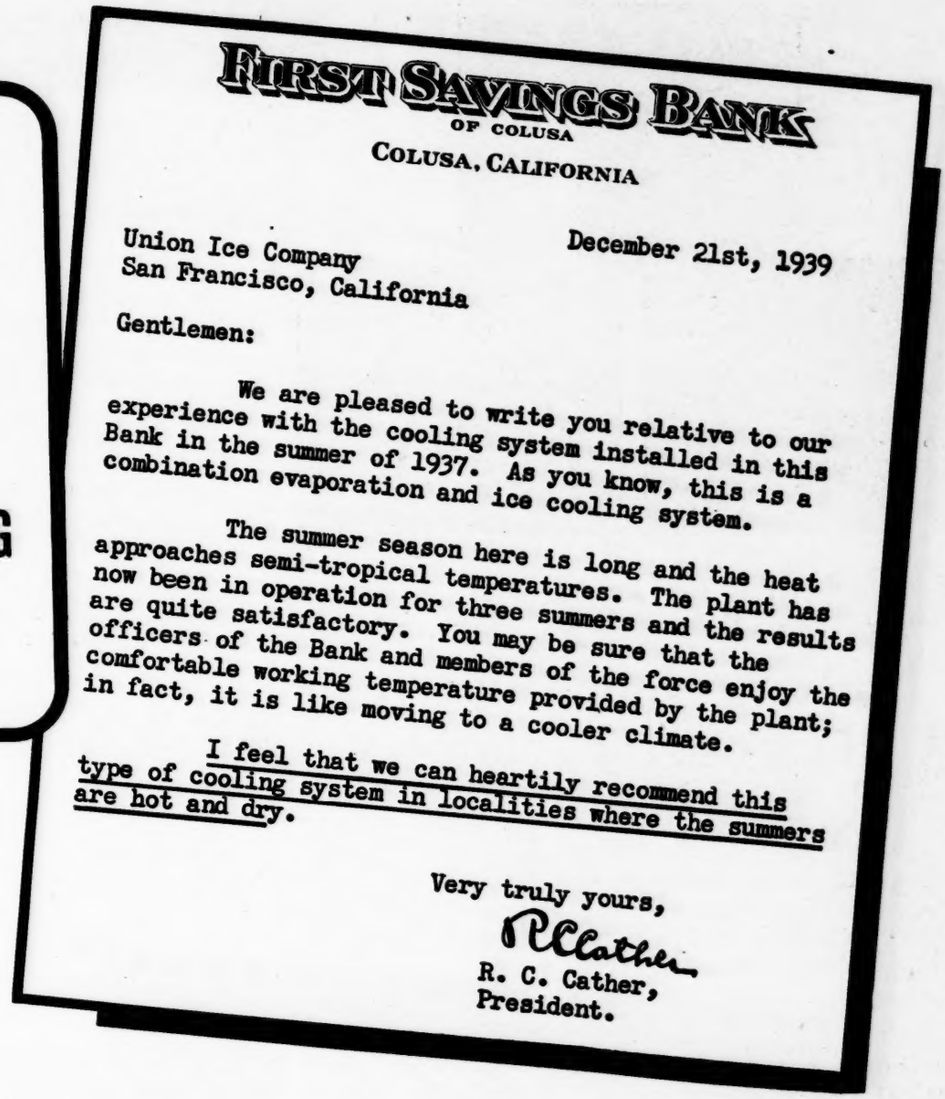
	Pittsburgh, Pa.	Portland, Me.	Portland, Oreg.	Providence, R. I.	Reading, Pa.	Reno, Nev.	Richmond, Va.
Degree-days for January, 1940.....	1381	1421	708	1313	1287	941	1172
Degree-days, Sept. 1, '39 to Jan. 31, '40	3243	4015	2064	3467	3168	2674	2676
Degree-days, Sept. 1, '38 to Jan. 31, '39	2738	3595	2183	3049	2803	3079	2082
Degree-days, Sept. 1, to Jan. 31, Normal	3003	3817	2530	3246	3102	3326	2232

	Rochester, N. Y.	St. Louis, Mo.	Salt Lake City, Utah	San Francisco, Calif.	Scranton, Pa.	Seattle, Wash.	Spokane, Wash.
Degree-days for January, 1940.....	1444	1479	1021	383	1387	608	1089
Degree-days, Sept. 1, '39 to Jan. 31, '40	3821	3060	2806	1056	3740	2037	3318
Degree-days, Sept. 1, '38 to Jan. 31, '39	3433	2311	3158	1252	3328	2242	3319
Degree-days, Sept. 1, to Jan. 31, Normal	3666	2798	3259	1414	3446	2656	3755

	Springfield, Ill.	Syracuse, N. Y.	Toledo Ohio	Trenton, N. J.	Utica, N. Y.	Washington, D. C.	Wichita, Kan.
Degree-days for January, 1940.....	1565	1483	1479	1285	1620	1244	1512
Degree-days, Sept. 1, '39 to Jan. 31, '40	3373	3942	3606	3217	4297	2856	3008
Degree-days, Sept. 1, '38 to Jan. 31, '39	2722	3472	3173	2810	3818	2399	2360
Degree-days, Sept. 1, to Jan. 31, Normal	3183	3768	3392	2774	3785	2711	2877

Methods of applying the degree-day in connection with the operation of heating plants or for the prediction of fuel consumption of heating plants are described fully in the new enlarged edition of the DEGREE-DAY HANDBOOK, published by HEATING & VENTILATING. 148 Lafayette Street, New York, price $3. Degree-days as given above for a "normal" month or season are based on averages for a long period of years, ending about 1922. Averages covering different periods will disagree with the above figures slightly.

THIS IS THE SORT OF SATISFACTION THAT BUILDS AIR-CONDITIONING BUSINESS



FIRST SAVINGS BANK
OF COLUSA
COLUSA, CALIFORNIA

December 21st, 1939

Union Ice Company
San Francisco, California

Gentlemen:

We are pleased to write you relative to our experience with the cooling system installed in this Bank in the summer of 1937. As you know, this is a combination evaporation and ice cooling system.

The summer season here is long and the heat approaches semi-tropical temperatures. The plant has now been in operation for three summers and the results are quite satisfactory. You may be sure that the officers of the Bank and members of the force enjoy the comfortable working temperature provided by the plant; in fact, it is like moving to a cooler climate.

I feel that we can heartily recommend this type of cooling system in localities where the summers are hot and dry.

Very truly yours,
R. C. Cather,
President.

Enthusiastic letters such as this from businesses of all sorts all over the country – from banks to cocktail bars – prove how well ICE air conditioning meets every requirement of economy and performance.

Simple – No other type of system is so simple to install. Elimination of complicated machinery in ice air conditioning means there is little chance of breakdowns, and no need for expert attendants. Ice air conditioning is easily regulated and operated.

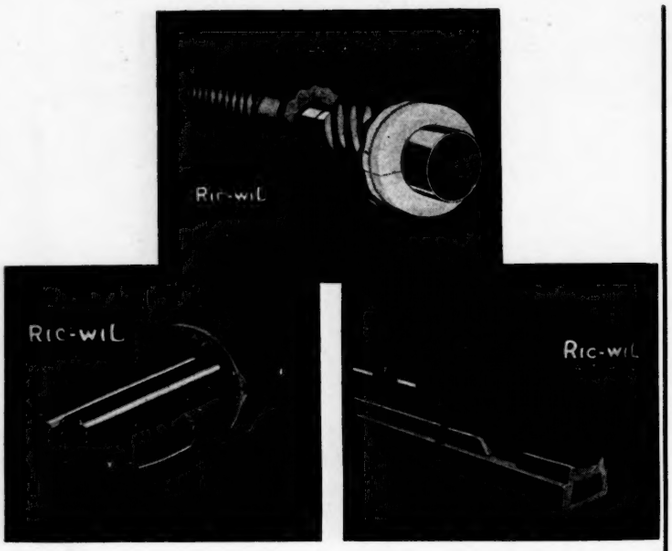
Effective – In an ice-using system, both temperature and humidity are controlled, the air is thoroughly cleaned and properly circulated and cooling is rapid—without need for prolonged precooling periods. Ice air conditioning is especially suitable where cooling is required on less than a 24 hour basis.

Economical – The initial cost of ice air conditioning averages less than half that of other types. Operating cost is low, since ice is melted only to supply needed refrigeration. Power cost and maintenance are negligible.

For efficient, flexible, economical air conditioning that will bring you more contracts, recommend *ice* air conditioning. Consult your local ice company or write:

NATIONAL ASSOCIATION OF ICE INDUSTRIES

228 North LaSalle Street, Chicago, Illinois



What Type of Underground Conduit is Best for You?

In the six basic types of Ric-wiL Underground Steam Conduit you find the most complete line on the market today. These designs afford a choice of all *approved* materials—tile, heavy-duty tile, Cast Iron, and Armco Hel-Cor Ingot Iron—and also a variety of insulations including the famous Dry-paC Waterproof Asbestos, standard sectional pipe coverings, and bulk commercial insulations.

All these Ric-wiL Systems are in successful use under actual service conditions. Underground steam protection has been Ric-wiL's *exclusive business* for a third of a century. Ric-wiL's engineering technique is unchallenged.

Now—with the most complete line available *anywhere*—Ric-wiL offers a range of materials and design which effectively meets *any* requirements of cost, function, soil, surface traffic, or labor man-hours.

One end in underground steam transmission is permanent efficiency. Another is economy—first and last. Ric-wiL can help you make *both ends meet*—and will, if you say so.

Write for Catalog showing all types of Ric-wiL Conduit.

The RIC-WIL Co., Union Commerce Bldg., Cleveland, Ohio
New York **San Francisco** **Chicago**
Agents in principal cities

REGISTERED IN U. S. PATENT OFFICE

RIC-WIL

CONDUIT SYSTEMS FOR UNDERGROUND STEAM PIPES

COMING EVENTS

MARCH 18-21. Ninth Annual Forced Warm Air Conference sponsored by the National Warm Air Heating and Air Conditioning Association. To be held at Michigan State College, East Lansing, Mich. Further information obtainable from Prof. L. G. Miller, Michigan State College, East Lansing, Mich.

MARCH 28-30. Third annual conference. Oregon State Air Conditioning Conference at Corvallis, Ore. General Chairman, Earl C. Willey, assistant professor of mechanical engineering, Oregon State College.

APRIL 9-10. Annual Midwest Power Conference; Palmer House, Chicago, under direction of Prof. S. E. Winston, 401 S. Quincy St., Hinsdale, Ill.

MAY 14-17. Annual meeting of the National District Heating Association; French Lick Springs Hotel, French Lick, Indiana. Further information available from John F. Collins, Jr., Secretary-Treasurer National District Heating Association, 1231 Grant Building, Philadelphia, Pa.

MAY 20-22. Annual convention of Association of Gas Appliance and Equipment Manufacturers, at the French Lick Springs Hotel, French Lick, Ind.

MAY 21-24. 34th annual convention of the Smoke Convention Association at Hotel Statler, St. Louis.

MAY 27-29. Contractors National Association at the Pennsylvania Hotel in New York.

MAY 27-29. 51st annual convention of the Heating, Piping and Air Conditioning Contractors National Association. To be held at the Hotel Pennsylvania, New York City.

JUNE 3-5. National Warm Air Heating and Air Conditioning Association, Mid-Year Meeting, Palmer House, Chicago. Managing Director, Allen W. Williams, 5 East Long Street, Columbus, Ohio.

JUNE 6-7. Stoker Manufacturers Association at Hot Springs, Va.

JUNE 9-11. Summer meeting of the American Society of Refrigerating Engineers. Will be held at Skytop, Pa.

JUNE 17-19. Summer meeting American Society of Heating and Ventilating Engineers. Will be held in Washington.

OCTOBER 8-11. The 69th annual meeting of the American Public Health Association, Detroit. Book-Cadillac Hotel, Headquarters.

H&V'S PHOTOS

Cover—Pontiac Motor Division, General Motors Sales Corporation, Detroit, Mich.

Page 17—United Air Lines, Chicago, Ill.

Pages 18, 19, 20—Akron Studios, New York City, for the Dravo Corporation, Pittsburgh, Pa.

Page 23—Avery Engineering Company, Cleveland, Ohio.

Page 25—T. R. Davis, office of C. R. Ammerman, Indianapolis, Ind.

Page 27—Upper two photos, Department of Welfare, State of Indiana. Lower photo, T. R. Davis, office of C. R. Ammerman, Indianapolis, Ind.

Page 28—Caterpillar Tractor Co., Peoria, Ill.

Pages 29, 31, 32, 33 and 34—Standard Register Co., Dayton, Ohio.

Page 35—American Fork & Hoe Company, Wallingford, Vermont.

WITH THE MANUFACTURERS

Airtemp Division, Chrysler Corp., Detroit, has appointed *R. L. Spitzley Heating Company,* 1200 W. Fort St., Detroit, as distributors of its air conditioning equipment. *J. George Fischer & Sons, Inc.,* 900 Lapeer St., Saginaw, have been appointed distributors of Airtemp All-In-One commercial air-conditioning equipment. The franchise given to the Saginaw firm covers a sales area that takes in 23 counties throughout the Thumb district and upper Michigan. Chrysler Airtemp Sales

Corporation has established a regional office in Detroit to supervise both heating and air conditioning distributors. The office is located at 12,200 Jefferson Ave., E.

American Machine and Metals, Inc., East Moline, Ill., has established an office in Pittsburgh, Pa., to handle its line of DeBothezat ventilating equipment. *R. A. Armstrong* will be in charge of sales in that area.

Bastian-Morley Co., Inc., La Porte Ind., has returned *Robert I. Smith* to its sales staff. Mr. Smith will have headquarters in Boston, and will work with the company's national distributor, Crane Co., contacting Crane branches in the New England states and in Albany and Syracuse.

Other changes announced by the company include moving *Granville G. Reynard* from South Bend to Portland, Ore., and transferring *Winfield L. Redding*, since 1935 in New York State for the company, to the La Porte sales division.

Chrysler Corp., Airtemp Division, Dayton, has appointed three new regional managers: *Adam J. Pataky*, former Dayton branch manager of the Holland Furnace Company, joins the Airtemp sales force as Southwestern district manager with headquarters in St. Louis; *Charles Gregg*, former zone manager for Airtemp in Washington, is promoted to the Boston office as New England regional manager, and *Arthur M. Suit* is named head of the Washington office as regional manager of the South Atlantic district. Mr. Suit was formerly with Griffith-Consumers Co., Airtemp distributor in Washington.

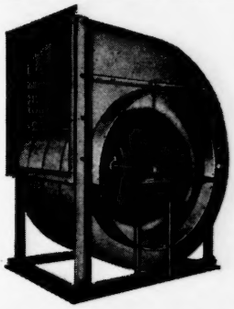
Electrol Incorporated, Clifton, N. J., has appointed 29 new dealers and has added *Charles B. Bendix* to its field sales force. Dealers appointed in New York State include Modern Automatic Heat, Poughkeepsie; Micheli Air Conditioning Co., Inc., Schenectady; Benedict Service Station, Pulaski; C&S Inc., Jamestown; Carmen Supply Co., Syracuse; Frank Crawford, Ogdensburg; C. L. Disbrow, Greene; Dock & Coal Co., Plattsburg; Fish & Kronenberg, Hamburg; C. S. Fooster, Massena; John J. Mahar, Hoosick Falls; Neville P.&H. Co., Ballston Spa; Osier Bros., Ticonderoga; Elmer R. Storie, Watertown; A. D. Wagoner, Adams; L. Willson, Malone; Warren J. Winne, Glens Falls; E. L. Zudeck, Kenmore; and David Ulmer, Cold Spring. Others include Northwest Equipment Co., Minneapolis, Minn.; Liberty Bell Oil Co., St. Louis, Mo.; Daly Bros., Waterbury, Conn.; C. M. Durr, Deep River, Conn.; R. L. Hatton Tin Shop, Ozona, Texas; J. D. Hickok, Lynchburg, Va., Manchester P.&H. Co., Manchester Centre, Vt.; C. M. Wilcox, Owosso, Mich.; Wm. Zepp, Bound Book, N. J. and B. J. Jutting, Highland Park, N. J.

Fairbanks, Morse & Co., Chicago, has re-zoned its territory and augmented its stoker sales organization, especially in the anthracite markets. *R. V. Anderson*, Syracuse, has been appointed for the New York State territory. *B. N. Powell*, Fayetteville, N. C., formerly a field engineer, has been promoted to district representative in the Carolina territory. *Harry H. Johns, Jr.*, has joined the staff to represent the company in the Western Pennsylvania district. *R. H. Stuff*, Cedar Rapids, Iowa, is now district representative for Minnesota, Nebraska, and Iowa.

GET THE JOB DONE Economically

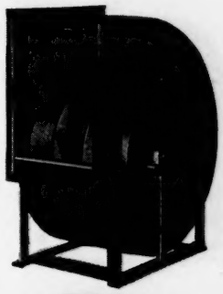
U.S.AIRCO BLOWERS

USAIRCO blowers fit into every system and into every budget. There's a size and type for every need at a price that makes USAIRCO blowers the most profitable equipment on the market. They are the result of 16 years of progressive engineering and specialized manufacture. All USAIRCO air conditioning equipment is fully guaranteed as to ratings and performance. USAIRCO is equipped to give fast service on special items. Write for details.



HEAVY DUTY BLOWER

USAIRCO Heavy Duty Blowers for ventilation through any size duct systems. Capacities from 2,000 to 70,000 C.F.M. Available in double and single inlet. Over 5,000 in use in schools, public buildings, theatres.



HEAVY DUTY BLOWER
Type A

USAIRCO Type A. Heavy duty. Backwardly curved blade. Non-overloading power characteristic. Wide range of sizes and capacities.

LIGHT DUTY BLOWER ASSEMBLY

USAIRCO Light Duty Blower Assembly. Also available in twin and triple assemblies. Capacities 800 C.F.M. to 4,000 C.F.M. Recommended for forced air furnaces and light duty air conditioning applications.

CO-OPERATIVE ENGINEERING SERVICE

Available to all factors in the industry are the services of USAIRCO's engineering staff, with a 16 year background in the successful design and application of air conditioning equipment for all types of work.

AIR WASHER

UNIT HEATER

UNIT HEATER BLOWER TYPE

HEAT CORE

UNIT COOLERS

SEND YOUR COMPLETE CATALOG

Name

Address

Town State

UNITED STATES AIR CONDITIONING CORP.
Northwestern Terminal, Minneapolis, Minn.
Export: U. S. Air Conditioning International, Inc. Graybar Bldg., New York
Canada: Canadian Air Conditioning Co., Ltd.

KNOW THE COMPANY AND THE LINE

TRADE FRICK MARK
Refrigeration
Using three big Frick Machines, totaling 650 tons capacity—a cooling effect equal to using 1,300,000 pounds of ice a day.
The air conditioning system, designed by Charles S. Leopold, includes radiant heating and cooling by pipes within the outside walls.
Tinsley, McBroom & Higgins, Architects: Pennsylvania Engineering Company, Contractors.
DEPENDABLE REFRIGERATION SINCE 1882
FRICK CO.
WAYNESBORO, PENNA. U.S.A.

General Electric Company, Bloomfield, N. J., has announced that central plant air conditioning and Industrial refrigeration equipment of more than 5 hp. will henceforth be sold directly to authorized contractors who, together with engineers and architects, will assume all application engineering and installation functions. *Samuel Martin, Jr.,* is head of the new contractor sales division. The contractors sales staff will function through a field organization separate from that handling the packaged products line. *D. C. McKinley* becomes field representative, with headquarters in Chicago, while *Hal Gibson* assumes similar responsibilities at Dallas. *E. T. Brockbank* and *W. F. Karsten* are assigned jointly to the New York area. *R. M. Ekings, Jr.,* will work with contractors in Washington, D. C., while *D. W. Howes* has been given general duties at headquarters in Bloomfield.

Revere Copper and Brass Incorporated, New York, has named *J. M. Read* of New Bedford, Mass. as director of the company.

The H. B. Smith Company, Inc., Westfield, Mass., has moved its New York office and show room to 331 Madison Avenue, New York. Telephone Vanderbilt 6-6076.

Underground Steam Construction Co., Boston, Mass., subsidiary of *E. B. Badger & Sons Co.,* has appointed *Charles E. Mayette* to its sales engineering staff. Mr. Mayette's activities will be mainly in connection with contracts for the installation of high pressure and high temperature piping for central stations, industrial and process plants.

Worthington Pump and Machinery Corp., Harrison, N. J., has elected *H. A. Feldbush* as a vice-president. Effective Feb. 23, Mr. Feldbush moved his headquarters to Holyoke, Mass., where he will have charge of operations of the corporation's Holyoke Works in the manufacture of air and refrigerating equipment. Mr. Feldbush was formerly general manager of the Carbondale Division of Worthington at the Harrison Works, and in his new capacity will continue as an active member of the Carbondale operating committee.

Worthington Pump and Machinery Corp., Harrison, N. J., announces that *Charles E. Wilson,* vice-president, in charge of the Pacific Coast operations of the corporation, is moving his headquarters to the home office at Harrison where he will direct the sales of all products handled by the Carbondale Division, which specializes in air conditioning and refrigeration equipment. In this work Mr. Wilson succeeds *H. A. Feldbush* who henceforth will devote his time to the manufacturing department of the corporation. Mr. Wilson is also assuming directional charge of the sales of all the corporation's products built at the Holyoke factory.

York Ice Machinery Corporation, York, Pa., has elected *William S. Shipley,* for the past ten years president of the company, chairman of the board of directors. *Stewart E. Lauer,* formerly vice-president, was elected president; *E. A. Kleinschmidt,* executive vice-president and *Llewellyn Williams,* vice-president in charge of engineering. Mr. Lauer, the new president, has been vice-president in charge of sales for several years.

York Ice Machinery Corp., York, Pa., has appointed *John R. Hertzler* as general sales manager and *Ralph B. Meisenhelder* as assistant to the president.

NEW TRADE LITERATURE

Boilers. A 4-page standard size catalog No. 99-2 describing the Kewanee Scotch marine type, low-pressure boiler. This boiler is said to be economical in first costs and is designed for any type buildings or size requiring a boiler with capacities ranging from 2680 to 42,500 sq. ft. steam radiator surface. KEWANEE BOILER CORPORATION, KEWANEE, ILL.

Controls. A standard size, 60-page catalog No. 400, illustrating and describing Mercoid automatic controls for heating, air conditioning, refrigeration and various types of industrial application. THE MERCOID CORPORATION, 4201 BELMONT AVE., CHICAGO, ILL.

Fans. A standard size catalog made up of a number of bulletins describing the line of Reed Unit-fans. Includes information on attic fans, exhaust fans, kitchen ventilators, exhaust vents and louvers. Gives information on the sizes and capacities available and installation instructions. REED UNIT-FANS, INC., 811 ST. CHARLES ST., NEW ORLEANS, LA.

Fans. An 18-page, standard size bulletin FU-22, on air circulating and ventilating equipment. In addition to the general discussion on air circulation and ventilation, the bulletin illustrates and describes the complete line of Wagner fans. WAGNER ELECTRIC CORPORATION, 6400 PLYMOUTH AVE., ST. LOUIS, MO.

Insulation. A standard size, 16-page bulletin entitled, "Proved Protection Against Wasted Profits." Bulletin describes and illustrates Philip Carey products designed for eliminating profit leaks in industrial plants. Among products described are heat insulations for temperatures from subzero to 2500F; Careyduct asbestos air conditioning ducts; Careycel for insulating air conditioning ducts and equipment; Carey Firefoil panel for the construction of air conditioning housings, air cooled boiler walls, and large air ducts; corrugated roofing and siding; roof coatings and floorings. THE PHILIP CAREY COMPANY, LOCKLAND, CINCINNATI, OHIO.

Pumps. A standard size, 24-page bulletin 5810 D on Fairbanks-Morse single stage, split case, centrifugal pumps. Bulletin includes tentative selection tables, typical specifications, principal dimensions and other engineering information required by engineers when selecting pump equipment. Bulletins are designed to enable the engineer to do a great deal of preparatory work directly from the bulletin. FAIRBANKS, MORSE & CO., 600 S. MICHIGAN AVE., CHICAGO, ILL.

Pulleys. A standard size 16-page booklet No. 860 covering all types of Rockwood paper pulleys for industrial use. It contains a complete list of stock sizes of pulleys which are immediately available, as well as information on current list prices. ROCKWOOD MANUFACTURING COMPANY, INDIANAPOLIS, IND.

Vibration Eliminators. An 8-page standard size bulletin entitled, "Korfund Vibration Control for Concrete Foundations." Describes and illustrates a number of typical installations and also gives data on the installation of Vibro insulators. THE KORFUND CO., INC., LONG ISLAND CITY, NEW YORK.

GET ACCURATE STEAM COSTS FOR HEATING, PROCESSING WITH THE

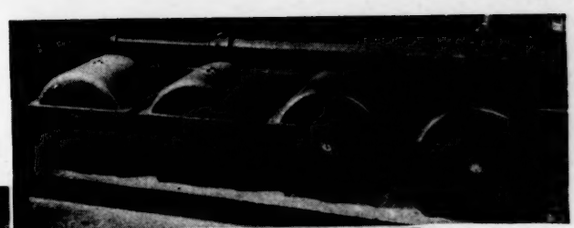
ADSCO ROTARY CONDENSATION METER

ECONOMICAL IN COST
EASILY INSTALLED—NO ORIFICES OR COMPLICATED MECHANISM

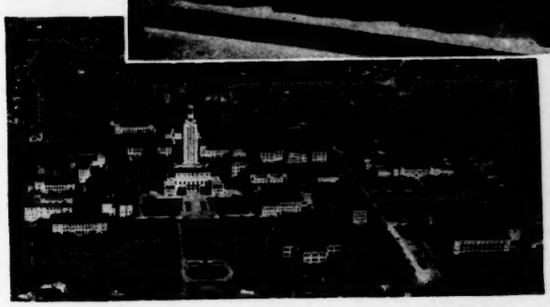
This meter measures steam consumption in the form of condensate and records directly in pounds on the counter mechanism. It will give you an accurate check on steam consumption by buildings, by department or processes to enable you to overcome steam waste, allocate costs and improve your heating efficiency.

Low in cost per unit of capacity, easily installed without orifices or complicated mechanism for gravity or vacuum operation. Available in 7 sizes from 250-12,000 lbs. per hour capacity. Factory tested to an accuracy within 1% at all rates of flow to 150% of capacity.

Write for illustrated Bulletin No. 35-80V which gives details of construction, method of operation and installation diagrams.



4 ADSCO Rotary Meters installed at Univ. of Texas, Austin, Tex.



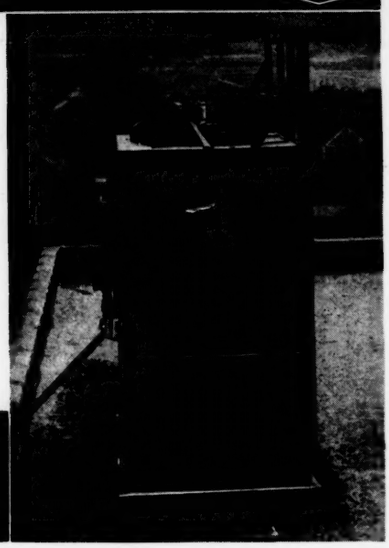
Birdseye view of Univ. of Texas. Note power house at right serving steam through underground lines to various buildings.

Used by leading colleges, institutions, industrial plants, public utility companies and government departments.

AMERICAN DISTRICT STEAM COMPANY
NORTH TONAWANDA, N.Y.
IN BUSINESS OVER SIXTY YEARS

BIG OR SMALL

Binks HAS THE RIGHT COOLING TOWER



There is a BINKS cooling tower for every size and type of air-conditioning installation. The towers illustrated here are of the highly efficient BINKS Induced Draft design. These towers are capable of constant heavy duty . . . are independent of natural wind movements . . . produce consistently lower final water temperatures . . . and occupy less space than regular atmospheric towers. However, these are but one type of equipment made by BINKS.

WRITE TODAY for a complete water cooling catalog and data book. It's a valuable addition to any technical library.

BINKS MANUFACTURING COMPANY

3114-40 CARROLL AVENUE . . CHICAGO, ILLINOIS

You can be absolutely certain of no rust or red hot water when you specify a Patterson Everdur, Pure Copper, or Copper-Lined Heater.

Patterson Heaters cannot possibly cause rust or red water because water never touches anything except copper—and you know copper won't rust.

No rust also means a practically everlasting heater.

Kelley Heaters are guaranteed to deliver all the hot water required, as hot as required and as fast as required. Write for catalog.

Patterson

The Patterson-Kelley Co., Inc.
105 Burson St.
East Stroudsburg, Pa.

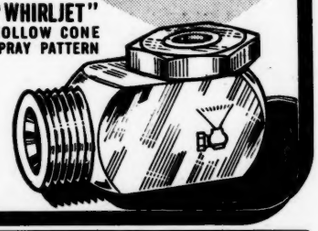
Everdur or Copper Lined Hot Water Heaters

NON-CLOGGING SPRAY NOZZLES *for* Air Conditioning

ALL SIZES
ALL TYPES
ALL CAPACITIES

Made in brass, Monel or stainless steel. Male or female connections. Atomizing nozzles, pneumatic or direct hydraulic, for humidifying. Send for new catalog.

"WHIRLJET" HOLLOW CONE SPRAY PATTERN

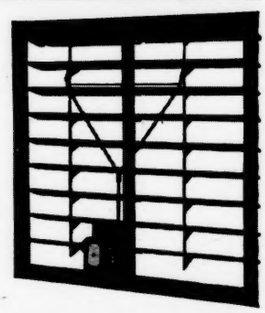


SPRAYING SYSTEMS CO.
4031 W. LAKE ST. CHICAGO

Elgo Ventilating Specialties

All-Steel Motorized Shutter

Automatically controlled by fan switch. Opens completely in 6 seconds. Shutters fit tightly when closed. Storm-proof. Constructed entirely of steel. Used for exhaust ventilation in industrial, commercial and residential buildings. Write for circular and prices.



Get our prices on Automatic, Stationary and Hand Operated Shutters, also Ceiling, Balanced and Back Draft Dampers.

Free CATALOG

Elgo Shutter & Manufacturing Co.
635 W. WARREN DETROIT, MICH.